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Some Borrowers Are More Equal than Others: Bank Funding Shocks and Credit Reallocation*

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Abstract

This paper provides evidence on the strategic lending decisions made by banks facing a negative funding shock. Using bank–firm level credit data, we show that banks reallocate credit within their loan portfolio in at least three different ways. First, banks reallocate to sectors where they have a high market share. Second, they also reallocate to sectors in which they are more specialized. Third, they reallocate credit toward low-risk firms. These reallocation effects are economically large. A standard deviation increase in sector market share, sector specialization, or firm soundness reduces the transmission of the funding shock to credit supply by 22%, 8%, and 10%, respectively.

JEL classification: G01, G21

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1. Introduction

The collapse of Lehman Brothers in September 2008 was an unprecedented shock to banks' funding opportunities. Several papers show that banks transmitted this funding shock to their borrowers.[1] However, recent evidence suggests that banks did not curtail credit equally across the board. De Haas and Van Horen (2012), Giannetti and Laeven (2012), and Liberti and Sturgess (2018) indicate that there is significant heterogeneity in the geographical reallocation decisions of banks.

While many researchers have analyzed the role that geographical specialization plays for credit reallocation after a funding shock, only few have focused on the impact of other types of lending specialization (DeYoung et al., 2015; Paravisini, Rappoport, and Schnabl, 2017; Liberti and Sturgess, 2018). This is somewhat surprising, given the important role that loan portfolio allocation plays in many theoretical banking models (Diamond, 1984; Boyd and Prescott, 1986; Winton, 1999) and given the severe consequences that credit reallocation after a funding shock might have for the real economy (Ongena, Peydro, and van Horen, 2015).

This paper aims to fill this gap in the literature by providing a comprehensive and detailed analysis of the reallocation that banks pursue across sectors and firms after a negative shock to their funding. The particular shock we focus on is the collapse of the interbank funding market that was triggered by the bankruptcy of Lehman Brothers. This event had a strong impact on the Belgian financial system. Figure 1 shows that the total volume of interbank funding of banks active in Belgium dropped from more than EUR 500 billion in August 2008, to around EUR 250 billion 13 months after the Lehman Brothers collapse.[2]

To identify the reallocation in the supply of credit following these funding problems, we rely on 160,223 fully documented bank–firm combinations. We combine monthly bank–firm level data from a comprehensive credit register that contains all credit granted in Belgium by all financial institutions, monthly balance sheets of these financial institutions, and annual balance sheets of all registered firms. The richness of our data allows us to study various measures of credit growth and makes it possible to disentangle credit supply from demand. The latter is done by saturating the corresponding loan growth specifications with a comprehensive set of fixed effects in order to control for credit demand (Khwaja and Mian, 2008; Jimenez et al., 2014).

We identify reallocation effects along three different lines based on a stylized expected return equation (see Section 2.2).[3] First, banks reallocate credit after a negative funding shock toward sectors in which they have a high market share (defined as the bank's share in

1 See Cetorelli and Goldberg (2011, 2012); Puri, Rocholl, and Steffen (2011); Claessens and van Horen (2013); Cull and Martinez Peria (2013); Albertazzi and Bottero (2014); Allen et al. (2014); Bertay (2014); De Haas and van Lelyveld (2014); and Iyer et al. (2014).

2 Interbank funding include overnight deposits, deposits redeemable at notice, and term accounts of other financial institutions as well as repurchase agreements.

3 The focus of the paper is on the reallocation effects, that is, the heterogeneous transmission of a funding shock. However, we also document the average (homogeneous) effect of the funding

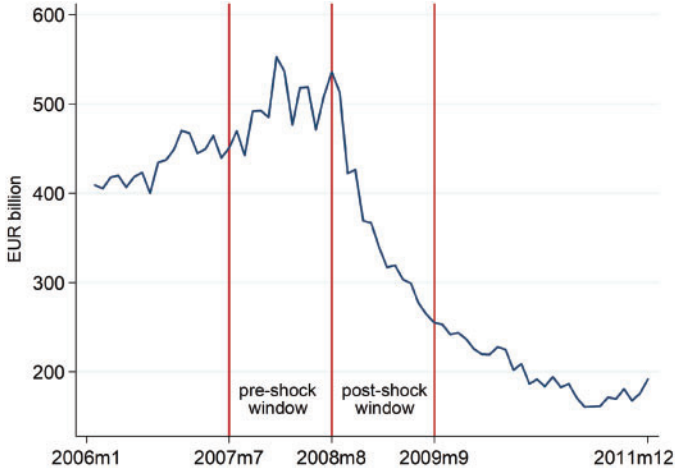

Figure 1. Aggregate interbank funding.
This figure depicts the evolution of the monthly aggregate volume (all banks active in Belgium, in EUR billion) of interbank funding over the period 2006:1–2011:12. Interbank funding includes overnight deposits, deposits redeemable at notice and term accounts of other financial institutions, as well as repurchase agreements. The vertical lines correspond to the estimation window (pre-shock window and post-shock-window of 13 months) around the collapse of Lehman Brothers in September 2008. The first line corresponds to July 2007, the second line corresponds to August 2008, and the third line corresponds to September 2009.

total credit granted to a sector). We find that a one standard deviation increase in sector market share reduces the negative impact of the funding shock on credit supply by 22% for the average firm.[4] The explanation for this finding is that banks direct their attention to sectors where they can more easily extract rents. As the funding shock increases the marginal cost of lending, banks start to prefer their inframarginal borrowers over their marginal borrowers. Banks that face a funding shock are forced to reduce lending, but they have an incentive to shield sectors where they can exploit their high market share and charge relatively higher interest rates.

Second, we find that banks reallocate credit toward sectors in which they are specialized (defined as the sector's share in total credit granted by a bank). A one standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 8% for the average firm.[5] Banks will typically have gathered more sector-specific (hard or soft) information in sectors where they are specialized, improving their screening abilities and reducing the need for costly monitoring in these sectors. As such, banks that

shock on bank credit supply. For example, our results indicate that the average reduction in interbank funding (10.3%) leads to a reduction in credit supply of 4.26 percentage points.

4 Twenty-two percent is the estimated average mitigation, due to a larger market share, of the average credit contraction following an interbank funding shock. This number is computed from the six main regression models in Table V.

5 Eight percent is the estimated average mitigation, due to sector specialization, of the average credit contraction following an interbank funding shock. This number is computed from the six main regression models in Table V.

face a funding shock are forced to reduce lending, but they have a strong incentive to shield sectors in which they are specialized and have superior screening and monitoring skills.

Third, banks hit by a funding shock reallocate credit toward safe firms. We find that banks transmit a funding shock less to firms with low debt levels, high collateral, and high interest coverage ratios. A one standard deviation decrease in firm risk (for any of these measures) reduces the negative impact of the funding shock on credit supply by on average 10%. Given that these safer firms are likely to have higher repayment probabilities, our results suggest that a loan's (long-term) repayment probabilities matter when banks make lending decisions after a funding shock.

The impact of these three reallocation effects is robust to a number of alternative explanations that might be driving loan portfolio allocations. Specifically, the banks that are hit the hardest by the funding shock are also the largest banks in our sample. Given that size correlates positively with having global banking activities and with the probability of getting government support during our sample period, one could be concerned that these factors are driving our results. We provide a number of robustness checks to ensure that our results are not driven by international diversification choices, government interventions, or pre-crisis solvency or liquidity issues that banks might have faced. Additionally, we show that it is unlikely that our results are driven by bank–firm-specific soft information which banks might have gathered through previous interactions with a specific firm. As such, our findings indicate that sector market share, sector specialization, and firm risk play a more important role than firm-specific relationships when it comes to the reallocation choices of banks during a funding shock.

After documenting these three reallocation channels, we investigate whether the magnitude of the impact of funding shocks changes over time and whether the impact persists.[6] We show that the moderating impact of bank sector market share is almost instantaneous and stays significant until 2 years after the shock. Bank sector specialization on the other hand becomes important for the reallocation of credit after about 10 months and also stays significant until 2 years after the shock. The moderating effect of firm risk becomes significant 3–4 months after the shock. Our results thus indicate that banks hit by a funding shock are at first more concerned with staying afloat in the short run by focusing on loans that ensure larger cash inflows (in the form of relatively high interest payments), while only being interested in long-term profitability (and hence focusing on protecting their sector-specific knowledge) and firm risk once these short-term inflows are safe.

Finally, we analyze the impact of the funding shock on firm investments and asset growth. Firms borrowing from banks that experience a larger funding outflow have a lower investment rate and grow slower than other firms. Importantly, this negative impact is partially offset for firms that are borrowing from banks with a high sector market share and for large firms. In economic terms, however, the real effects of the shock are rather moderate.

Our paper adds to the literature in a number of ways. First, our analysis contributes to the rapidly expanding literature on bank funding shock transmission. The existing work on

6 The detailed timing of the reallocative impact of market-wide, bank-, or borrower-specific events is rarely investigated due to a lack of granular data, except in selected settings such as bank runs (Iyer, Puri, and Ryan, 2012), bank mergers and acquisitions (see, e.g., Sapienza, 2002; Focarelli and Panetta, 2003; Degryse, Masschelein, and Mitchell, 2011), or borrower lock-in (Ioannidou and Ongena, 2010).

funding shocks and bank lending mainly focuses on cross-border effects through global banks (Peek and Rosengren, 1997, 2000; Cetorelli and Goldberg, 2011, 2012; Claessens and van Horen, 2013; Albertazzi and Bottero, 2014; Bertay, 2014; De Haas and van Lelyveld, 2014; Liberti and Sturgess, 2018). Others have focused on the average reduction in credit (Puri, Rocholl, and Steffen, 2011; Iyer et al., 2014), or on the real effects of funding shocks (Chodorow-Reich, 2014; Paravisini et al., 2014; Ongena, Peydro, and van Horen, 2015). A number of recent papers show that bank–firm relationships shield firms from credit supply shocks (Puri, Rocholl, and Steffen, 2011; DeYoung et al., 2015; Liberti and Sturgess, 2018), and that banks reallocate credit to less risky borrowers (Liberti and Sturgess, 2018) or less risky sector–region combinations (Ongena, Tumer-Alkan, and von Westernhagen, 2018) after a liquidity shock. DeYoung et al. (2015) use a structural model to examine how US community banks' past lending decisions affect small business credit granted in times of crisis. We add to this literature by providing a detailed overview of the reallocation of credit across sectors and firms based on bank sector market share and bank sector specialization.

Furthermore, by showing that banks reallocate credit according to their sector market share, this paper relates to a vast empirical literature on bank market share, market power, and credit [see, e.g., Degryse, Kim, and Ongena (2009) for a review]. We contribute to this literature by documenting that when banks face severe funding shocks, firms borrowing from banks with a higher sector market share are better protected against credit supply shocks. This finding entails important information for bank competition regulators, as it illustrates a potential benefit of bank concentration within a sector. Additionally, by showing that sector concentration matters, this result indirectly questions the strong focus of bank competition regulators and researchers on indicators that solely focus on the geographical dimension of bank competition.

The finding that banks reallocate credit according to sector specialization connects the bank funding shock transmission literature with the literature on bank lending concentration (Acharya, Hasan, and Saunders, 2006; Degryse and Ongena, 2007; Tabak, Fazio, and Cajueiro, 2011; Jahn, Memmel, and Pfingsten, 2016; Beck, De Jonghe, and Mulier, 2017). So far none of these papers comprehensively assesses reallocation of credit according to sector specialization or the potential benefits and dangers of bank lending concentration for firms. Both our paper and Paravisini, Rappoport, and Schnabl (2017) address these issues, albeit from a different perspective. Paravisini, Rappoport, and Schnabl (2017) document that credit supply shocks affect a firm's exports to markets where its lender specializes in. Our paper shows that firms that are borrowing from specialized banks are less impacted by a bank funding shock. This is consistent with previous literature showing that there is a potential downside to bank diversification (Laeven and Levine, 2007). Related to this, our results emphasize that not only systemic risk and financial stability issues should be taken into account when studying the welfare implications of bank portfolio diversification (e.g., Acharya, 2009; Wagner, 2010), but that it could also be relevant to consider the impact on firm credit supply. This is useful information for bank regulators when deciding on lending concentration limits.

Finally, our paper relates to the literature on firm characteristics and credit constraints. Researchers have proposed various classification schemes to identify financing constraints based on firm size and age (Beck et al., 2006; Hadlock and Pierce, 2010), asset tangibility (Almeida and Campello, 2007), or leverage and cash flows (Lamont, Polk, and Saa-Requejo, 2001; Whited and Wu, 2006). We add to this literature by showing that collateral availability, leverage, and interest coverage matter for credit supply when bank funding is under stress. However, we do not find any evidence that banks tighten credit supply disproportionately more for smaller or younger borrowers when their funding is under stress. We do find that a given credit supply shock matters more for the investment and growth of small firms than large firms, likely because the former have fewer alternative funding sources available.

Our paper is organized as follows. First, we discuss the data in Section 2.1, provide a detailed description of the hypotheses we want to test in Section 2.2, and discuss the empirical methodology in Section 2.3. Next, Section 3 provides the results on the average impact of the interbank funding shock as well as the reallocation effects. In Section 4, we focus on challenges to identification and causality as well as the robustness of the main findings. Section 5 provides insights in the timing of funding shock impact and the timing of the reallocation channels. Section 6 investigates whether the funding shock has real effects on firm investment and growth. Section 7 concludes.

2. Data, Hypotheses, and Methodology

2.1 Data

We combine information from three data sources available at the National Bank of Belgium (Belgium's central bank, henceforth NBB): The central corporate credit register, the regulatory bank balance sheets and income statements, and firm balance sheets and income statements.

Bank–firm-month level credit data are extracted from the corporate credit register, which collects information on credit granted by credit institutions and other types of financial institutions (leasing companies, factoring companies, and insurance companies) to legal entities (i.e., enterprises) and individuals with a business activity. We only include credit institutions established in Belgium and licensed by the NBB. This includes both branches incorporated under foreign law that are established in Belgium and institutions incorporated under Belgian law. A credit institution needs to provide information to the credit register on a monthly basis on all debtors to which they have an aggregate exposure of granted credit exceeding EUR 25,000.[7] We exclude firms operating in the financial or insurance sector, public administration, education, household activities, or activities of extraterritorial entities. The final sample includes firms from sixteen sectors of which the five most important ones are wholesale and retail trade, construction, professional activities, real estate, and manufacturing.

We construct three credit growth measures at the bank–firm level. First, $\Delta\%\ \text{Credit}_{bf}$ is defined as the logarithmic difference between the post-shock averaged (2008:9–2009:9) and the pre-shock averaged (2007:8–2008:8) values of the granted amount by bank b to firm f. Secondly, we create a dummy variable (Increase in credit_{bf}) which takes the value of 1 if credit growth was strictly positive and zero otherwise. Doing so, this variable

7 The Belgian corporate credit register reports two variables with monthly frequency related to the amount of credit: the credit granted and the credit utilized. The credit granted (or authorized) is the total amount in euro that a firm is allowed to borrow from a bank in that month. The credit utilized is the total amount in euro that a firm is actually borrowing from the bank in that month (hence, credit outstanding). The latter may be lower than the former when a firm has a credit line with that bank which it does not fully draw upon. We work with the credit granted to estimate the effect of bank funding on credit supply as changes in utilized credit are more likely to be contaminated by credit demand.

emphasizes the effect on the propensity to grant extra credit. Thirdly, we create a dummy (Large decrease in credit$_{bf}$) which equals one if the firm's credit growth is in the lowest quartile of credit growth of all the bank–firm observations in the sample (corresponding with a reduction of 15.37% or more). This variable proxies for granted amounts that have been reduced substantially, or matured without having been rolled over.

We also use the credit data to construct our two main variables that are expected to be important for credit reallocation after a funding shock (we derive the hypotheses in Section 2.2). Bank sector market share$_{bs}$ is defined as the ratio of total credit granted by bank b to sector s relative to the total credit granted by all banks to sector s, in the pre-shock period (2007:8–2008:8):

$$\text{Bank sector market share}_{bs} = \frac{\sum_{f=1}^{F} L_{bfs}}{\sum_{b=1}^{B} \sum_{f=1}^{F} L_{bfs}}, \tag{1}$$

where L_{bfs} is the credit granted by bank b to firm f in sector s and F (B) is the total number of firms (banks).

Bank sector specialization$_{bs}$ is defined as the ratio of total credit granted by bank b to sector s relative to bank b's total credit granted, in the pre-shock period (2007:8–2008:8):

$$\text{Bank sector specialization}_{bs} = \frac{\sum_{f=1}^{F} L_{bfs}}{\sum_{s=1}^{S} \sum_{f=1}^{F} L_{bfs}}. \tag{2}$$

Bank sector market share is thus the importance of a bank for a sector, while bank sector specialization is the importance of a sector for a bank. Note that both variables vary at the bank-sector level.[8] In our empirical setup, we use the pre-shock time-averaged values of these variables, in line with the treatment of the credit and funding measures.

Bank balance sheets and income statements are gathered from the monthly regulatory filings ("Schema A") at the National Bank of Belgium. We use the unconsolidated statements as these allow us to focus on the Belgian operations of the banks. The Belgian banking market is quite concentrated; in 2007 the share of the largest five credit institutions in total banking assets was 83% (ECB, 2008). Out of the thirty-eight banks in the sample, sixteen are domestic. Ten of the foreign banks are subsidiaries, the remaining twelve operate as branches incorporated under foreign law. The domestic banks are substantially larger and cover 71% (82%) of the entire corporate credit market (banking market) during our sample period.

The interbank funding shock (Δ% Interbank funding$_{b}$) is defined as the average value of interbank funding post-shock minus the average value pre-shock, scaled by the average total assets pre-shock. This focus on interbank funding is in line with the existing literature [see, e.g., Iyer et al. (2014), and Ippolito et al. (2016)].[9] To avoid serial correlation in the

8 Within and across sectors, we find substantial variation in sector market share and sector specialization. The average standard deviation (across the five most important sectors) of sector market share is 6.5% and of sector specialization is 12% (relative to average means of 2.7% and 14%). In addition, we observe for most sectors that both large and small banks appear in the outer quartiles (or terciles) of the sector specialization measures.

9 Ippolito et al. (2016) and Iyer et al. (2014) use the level of gross interbank funding, whereas Acharya and Mora (2015) uses net interbank funding. Ippolito et al. (2016) argue that gross interbank funding is preferred over net borrowing, as the former better captures the extent to which a bank is exposed to a run on its funding during the crisis. Moreover, in contrast to the

standard errors, we first average the monthly data for the credit growth and funding shock measures to obtain one pre-shock observation and one-post shock observation at the bank–firm level (Bertrand, Duflo, and Mullainathan, 2004). We limit the pre-shock window to 13 months to use the maximum amount of information available without interference from other shocks [e.g., the turmoil in the ABCP market starting at the end of July 2007, as in Iyer et al. (2014)].[10]

At the bank–firm level, the average value of the interbank funding shock is −10.3%. This outflow is predominantly due to a reduction in cross-border interbank funding, and hardly due to liquidity hoarding of Belgian banks who stop lending to each other. The interbank funding shock is negative for the median bank, but positive on average. This is due to the construction of the shock as the difference in the average value of (monthly) interbank funding over the year post- versus the year pre-Lehman's failure [this construction is similar to the setup of Khwaja and Mian (2008)]. The actual outflow in interbank funding in the year following the Lehman bankruptcy (i.e., the difference between August 2009 and August 2008) has both a negative mean (−4.3%) and median (−1.5%). The between bank variation in both interbank funding shock measures is very similar (a standard deviation of 11.9% and 11.3%) and both shocks are strongly and significantly correlated. Hence, the way one looks at the interbank funding shock does not significantly influence the information that is included in the shock measure.

We further compute a number of bank characteristics based on the average over the pre-shock window (2007:8–2008:8). We consider banks' reliance on interbank funding (interbank funding to total assets), bank capitalization (common equity to total assets), bank profitability (return on average equity),[11] credit risk (write-offs to total loans), liquidity ratio (interbank assets plus cash over total assets), stable deposit funding (demand and savings deposits to total assets), and bank size (natural logarithm of total assets).

Firm balance sheets and income statements are collected by the NBB which also performs a number of consistency checks on the data. Almost all Belgian firms incorporated under limited liability (irrespective of their size) are obliged to report. The most notable exceptions are sole traders or corporations whose legal situation implies an unlimited liability for the owner (typically very small firms). We match the last available firm balance sheet and income statement data prior to the Lehman collapse with the bank–firm credit exposures and bank balance sheets. From the 134,368 firms that are present in the credit register, 117,166 file balance sheets.

aforementioned authors, our set-up follows Khwaja and Mian (2008) by using the realization of the shock (i.e., the change in interbank funding) and not the exposure to the shock. In this case, excluding the change in interbank assets is even more important as maintaining or cutting interbank lending during the global financial crisis is by and large the bank's own choice and thus a decision variable rather than an exogenous shock.

10 Initially, we use symmetric windows and hence also use a 13 month post-shock period. However, in some parts of the analysis, we use expanding post-shock windows varying in length between 1 month and 24 months to analyze the timing and time-varying magnitude of the reallocation behavior. Furthermore, we will show that the chosen length of the pre-shock window is not really important for our findings as the turmoil in the ABCP market had no effect on the funding and credit reallocation of Belgian banks.

11 One bank in our sample has more than 100% return on equity pre-shock, which is in large part driven by a very low level of common equity.

We compute a measure of firm size (pre-shock total assets), age (pre-shock number of years since incorporation), leverage (pre-shock total debt to pre-shock total assets), collateral availability (pre-shock pledged collateral to pre-shock tangible fixed assets), financial pressure (pre-shock interest payments to pre-shock EBIT), and implicit interest rate (pre-shock interest payments to pre-shock financial debt).

Information on the construction of all variables is reported in Table I, whereas summary statistics are reported in Table II.

2.2 Hypothesis Development

In this section, we formulate our main hypotheses. To do so, we start from the following stylized expected return equation for a loan:

$$E[R_K] = p * R_L + (1 - p) * \gamma - c,$$

where $E[R_K]$ is the expected return, the borrower is either successful (with probability, p) or fails, R_L is the contractually agreed interest rate, γ is the recovery rate upon default, and c are the costs associated with originating one unit of the loan.

A funding shock could either lead to an increase in c for a given level of funding, or a drop in the availability of funds for a given level of c. In both situations, a bank will start cutting on its marginal borrowers, either because the increase in funding costs makes them negative NPV projects or because the funding constraint leads the bank to prefer the inframarginal borrower over the marginal borrower. This inframarginal borrower can differ in three dimensions from the marginal borrower. All else equal, borrowers with a higher repayment probability (p), borrowers with a higher contractual interest rate (R_L), or borrowers with a higher recovery value upon default (γ) will yield a higher return.

If a bank has a dominant position in a market segment, it will be able to charge borrowers in that segment a higher contractual interest rate. Therefore, when a bank faces a negative funding shock, it will—all else equal—shield those borrowers in that market segment. In this paper, we look at sectors as the relevant market segment and take banks' sector market share as a proxy for pricing power in that sector (implying higher R_L). Panel A of Table III supports the assumption that a dominant market position typically leads to higher interest rates. We find that, during the year before the Lehman collapse, firms borrowing from banks with a larger sector market share pay higher interest rates, holding constant other firm and bank characteristics.[12] On average over the three specifications reported in panel A of Table III, we find that a one standard deviation increase in sector market share leads to a 40 basis points increase in the implicit interest rate (which has an unconditional mean of 11.6%). This leads us to formulate the following hypothesis:

> H1 Bank sector market share: A bank that faces a negative funding shock will transmit this shock relatively less to borrowers operating in sectors where the bank has a larger market share.

Banks that have more and better information about their borrowers are better able to assess the repayment probabilities of these borrowers as well as their recovery values in case of default. While more and better information is beneficial, collecting information about every

12 Given that we do not have information on contractual interest rates, we compute firms' implicit interest rate from firm balance sheets—defined as interest expenses over financial debt—as a proxy for the actual interest rate. We only include firms borrowing from one bank in this test, as for these firms the implicit interest rate variable can more clearly be related to the specific bank and its sector market share.

Table I. Variable definitions

CREDIT VARIABLES	
Δ% Credit$_{bf}$	Natural logarithm of time-averaged credit granted post shock – natural logarithm of time-averaged credit granted pre shock
Increase in credit$_{bf}$	A dummy = 1 if Δ% Credit$_{bf}$ > 0 and 0 otherwise
Large decrease in credit$_{bf}$	A dummy = 1 if Δ% Credit$_{bf}$ is in the lowest quartile of the distribution, and 0 otherwise
	Credit granted is the total amount in euro that a firm is allowed to borrow from a bank. This may differ from the total actual outstanding credit amount a firm has with that bank when a firm, for instance, also has unused portions of a credit line with that bank.
BANK VARIABLES	
Δ% interbank funding$_b$	(Time-averaged interbank liabilities post shock – time-averaged interbank liabilities pre-shock)/time-averaged total assets pre-shock
Capital-to-total assets$_b$	Time-averaged common equity pre-shock/time-averaged total assets pre-shock
Return on equity$_b$	Time-averaged quarterly return on average equity pre-shock
Credit risk$_b$	Time-averaged net flow of new impairment for credit losses expressed as a percentage of time-averaged total loans pre-shock
Liquidity ratio$_b$	Time-averaged interbank assets + cash pre-shock/time-averaged total assets pre-shock
Deposits to total assets$_b$	Time-averaged demand and savings deposits pre-shock/time-averaged total assets pre-shock
Bank size$_b$	Natural logarithm of time-averaged total assets pre-shock demand and savings deposits include all deposits by households, non-financial corporations, and government institutions.
Interbank funding to total assets$_b$	Time-averaged interbank liabilities pre-shock/time-averaged total assets pre-shock
	Interbank liabilities include overnight deposits, deposits redeemable at notice, and term accounts of other financial institutions as well as repurchase agreements.
BANK-SECTOR VARIABLES	
Sector market share$_{bs}$	Time-averaged total credit granted pre-shock by bank *b* in sector *s*/time-averaged total credit granted pre-shock in sector *s*
Sector specialization$_{bs}$	Time-averaged total credit granted pre-shock by bank *b* in sector *s*/time-averaged total credit granted pre-shock by bank *b*
FIRM VARIABLES	
Total assets$_f$	Pre-shock natural logarithm of total assets
Age$_f$	Pre-shock number of years since incorporation
Leverage$_f$	Pre-shock total debt/pre-shock total assets
Financial pressure$_f$	Pre-shock total interest payments/pre-shock EBIT
Pledged collateral-to-fixed assets$_f$	Pre-shock pledged collateral/pre-shock tangible fixed assets
Implicit interest rate$_f$	Pre-shock total interest payments/pre-shock financial debt
Δ% Fixed assets$_f$	(Post-shock tangible fixed assets – pre-shock tangible fixed assets)/pre-shock total assets
Δ% Assets$_f$	(Post-shock total assets – pre-shock total assets)/pre-shock total assets

Table II. Summary statistics

	Observation	Mean	Standard deviation	Min	p25	p50	p75	Max
CREDIT VARIABLES								
Bank–firm level								
Δ% Credit$_{bf}$	160,223	−0.024	0.278	−0.644	−0.155	−0.051	0.026	0.941
Increase in credit$_{bf}$	160,223	0.289	0.453	0	0	0	1	1
Large decrease in credit$_{bf}$	160,223	0.250	0.434	0	0	0	1	1
BANK VARIABLES								
Bank–firm level								
Δ% Interbank funding$_b$	160,223	−0.103	0.063	−0.163	−0.163	−0.110	−0.091	0.301
Capital-to-total assets$_b$	160,223	0.045	0.021	0.001	0.041	0.041	0.056	0.356
Return on equity$_b$	160,223	0.080	0.116	−0.131	−0.072	0.106	0.172	1.009
Credit risk$_b$	160,223	0.026	0.025	−0.203	0.007	0.027	0.055	0.213
Liquidity ratio$_b$	160,223	0.244	0.086	0.016	0.239	0.265	0.280	0.741
Deposits to total assets$_b$	160,223	0.404	0.146	0.000	0.248	0.406	0.445	0.881
Interbank funding to total assets$_b$	160,223	0.320	0.112	0.000	0.293	0.342	0.374	0.936
Bank size$_b$	160,223	11.888	1.598	5.362	11.894	12.348	13.232	13.232
Bank level								
Δ% Interbank funding$_b$	38	0.020	0.119	−0.163	−0.045	−0.002	0.051	0.301
Capital-to-total assets$_b$	38	0.070	0.076	0.001	0.034	0.055	0.077	0.356
Return on equity$_b$	38	0.152	0.254	−0.131	0.014	0.109	0.161	1.009
Credit risk$_b$	38	0.007	0.084	−0.203	0.000	0.000	0.025	0.213
Liquidity ratio$_b$	38	0.270	0.244	0.016	0.067	0.170	0.416	0.741
Deposits to total assets$_b$	38	0.473	0.263	0.000	0.286	0.512	0.668	0.881
Bank size$_b$	38	8.203	1.895	5.362	6.952	7.865	9.060	13.232
Interbank funding to total assets$_b$	38	0.330	0.290	0.000	0.110	0.257	0.442	0.936
BANK-SECTOR VARIABLES								
Bank–firm level								
Sector market share$_{bs}$	160,223	0.181	0.084	0.000	0.158	0.207	0.241	0.267
Sector specialization$_{bs}$	160,223	0.129	0.083	0.000	0.065	0.126	0.208	0.588
Bank-sector level								
Sector market share$_{bs}$	402	0.038	0.075	0.000	0.001	0.003	0.017	0.267
Sector specialization$_{bs}$	402	0.088	0.124	0.000	0.011	0.043	0.108	0.588
FIRM VARIABLES								
Bank–firm level								
Total assets$_f$	141,762	13.38	1.288	10.79	12.47	13.24	14.16	16.46
Age$_f$	141,762	13.97	10.19	0.615	5.615	12.46	19.61	39.53
Leverage$_f$	141,762	0.724	0.263	0.126	0.559	0.745	0.887	1.561
Financial pressure$_f$	141,762	0.732	0.824	0.011	0.190	0.468	0.979	4.455
Pledged collateral to fixed assets$_f$	141,762	0.484	0.944	0.000	0.000	0.000	0.620	4.219
Firm level								
Total assets$_f$	117,166	13.18	1.209	10.79	12.35	13.06	13.89	16.46
Age$_f$	117,166	13.03	9.773	0.615	5.15	11.15	18.61	39.53
Leverage$_f$	117,166	0.726	0.272	0.126	0.552	0.746	0.895	1.561
Financial pressure$_f$	117,166	0.744	0.839	0.011	0.184	0.469	1.026	4.455
Pledged collateral to fixed assets$_f$	117,166	0.442	0.901	0.000	0.000	0.000	0.458	4.219
Δ% Fixed assets$_f$	114,436	0.078	0.410	−0.435	−0.082	−0.020	0.066	2.674
Δ% Assets$_f$	114,436	0.168	0.652	−0.681	−0.126	0.005	0.235	4.289

Table III. Sector market share, sector specialization, implicit interest rates, and default probabilities

Panel A of this table documents the relationship, during the pre-shock period, between a firm's implicit interest rate (derived from the firm's balance sheet) and the sector market share and specialization of its bank. We only include firms borrowing from one bank to improve the match between the implicit interest rate and the actual interest rate charged by the bank. The dependent variable in panel A is the implicit interest rate of the firm prior to the collapse of Lehman Brothers and is measured as interest expenses over financial debt. The estimated equation looks as follows:

$$\text{Rate}_f = \beta_1 \text{ Sector market share}_{bs} + \beta_2 \text{ Sector specialization}_{bs} + \delta_1 \text{ Bank controls}_b + \delta_2 \text{ Firm controls}_f + \alpha_{lss} + \epsilon_f .$$

In Column 1 of Panel A, we regress the implicit interest rate on bank sector market share, bank sector specialization, as well as firm cluster-fixed effects, where clusters are based on location–sector–size (lss) triplets. In Columns 2 and 3, we subsequently add firm controls and bank controls. Panel B of this table documents the relationship, during the pre-shock period, between borrower bankruptcy at the bank-sectoral level and the sector market share and sector specialization of the bank. The estimated equation looks as follows:

$$\text{Bankrupt}_{bs} = \beta_1 \text{ Sector market share}_{bs} + \beta_2 \text{ Sector specialization}_{bs} + \alpha_s + \epsilon_{bs} .$$

The dependent variable in Columns 1 and 2 is the number of borrowers that a bank is lending to in a given sector in the 2 years prior to Lehman, that go bankrupt prior to the funding shock. In Columns 3 and 4, the dependent variable is the exposure of each bank to bankruptcies in a given sector, in the pre-Lehman period. It is computed as the ratio the total number of firms going bankrupt in a sector that borrow from bank *b* to the total number of firms going bankrupt in that sector. All columns include sector-fixed effects (α_s). Columns 1 and 3 include all bank–sector observations, while Columns 2 and 4 include only bank–sector observations with strictly positive observations for the dependent variable. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Panel A	(1) Implicit interest rate$_f$	(2) Implicit interest rate$_f$	(3) Implicit interest rate$_f$
Sector market share$_{bs}$	0.058***	0.039***	0.050***
	(0.012)	(0.010)	(0.012)
Sector specialization$_{bs}$	0.016	−0.002	−0.013
	(0.016)	(0.017)	(0.016)
Firm cluster FE	Yes	Yes	Yes
Firm controls	No	Yes	Yes
Bank controls	No	No	Yes
Observations	89,926	89,926	89,926
R-squared	0.006	0.214	0.279

Panel B	(1) Number of bankrupt firms$_{bs}$	(2)	(3) Share of the sector's bankrupt firms$_{bs}$	(4)
Sector market share$_{bs}$	203.2***	227.9***	0.997***	0.970***
	(23.36)	(23.65)	(0.120)	(0.108)
Sector specialization$_{bs}$	−10.83**	−26.22**	−0.041***	−0.073***
	(4.349)	(9.921)	(0.011)	(0.022)
Sector FE	Yes	Yes	Yes	Yes
Observations	513	246	513	246
R-squared	0.684	0.762	0.824	0.864

borrower is costly. However, there are economies of scale with respect to the information collection within a given market segment. Banks that invest more resources in a given market segment gain an information advantage in that segment that allows them to better screen prospective borrowers and to more efficiently monitor existing borrowers (implying higher p and γ, respectively).[13] Taking sectors as the relevant market segment, we define banks' sector specialization as the share of the sector in the banks' total lending. Bank sector specialization thus proxies for the amount of resources that a bank has invested in a given sector and hence proxies for the information advantage that the bank has gained in that sector.

We provide tentative evidence that banks in our sample have an information advantage in sectors in which they are specialized. In Panel B of Table III we focus on borrowers that went bankrupt in the year prior to the Lehman collapse. The results document that the number of bankrupt firms in a bank-sector combination (Columns 1 and 2) as well as the bank's share in a given sector's bankruptcies (Columns 3 and 4) is smaller for a bank with a higher sector specialization, holding constant the bank's market share and sector specificities.[14] On average over the four specifications reported in panel B of Table III, we find that a one standard deviation increase in sector specialization leads to a 19.4% reduction of the dependent variable (relative to its unconditional mean). This suggests that specialized banks are better able to select good projects and will have an incentive to protect this information advantage. This finding is in line with Berger, Minnis, and Sutherland (2017) and leads us to formulate the following hypothesis:

> H2 Bank sector specialization: A bank that faces a negative funding shock will transmit this shock relatively less to borrowers operating in sectors where the bank has a larger sector specialization.

13 One could also think about p as the average repayment probability: $p = \phi p_H + (1-\phi)p_L$, as in, for example, Sharpe (1990). Specialization then provides the bank with a better signal of whether borrower quality is p_H or p_L.

14 Sector-fixed effects control for the sectors' different size and riskiness, whereas sector market share controls for a bank's relevance for the sector. The significant and positive relationship between sector market share and the dependent variables in panel B could be explained due to the possibility that higher loan rates could imply (weakly) higher bankruptcy risk for bank borrowers (see, e.g., Boyd and De Nicolo, 2005). The relation is also partly mechanical. All else equal, a bank with a larger market share in a given sector will have a larger part of the borrowers that declare bankruptcy in that sector.

Finally, it is interesting to analyze how firm characteristics impact credit reallocation. Risky borrowers might provide higher cash flows. Safe borrowers will likely have higher repayment probabilities. Both characteristics could thus lead to shielding. Which effect dominates remains an empirical question. Additionally, the degree of bank sector market share or specialization could be correlated with borrower characteristics. Testing them jointly will allow us to rule out that the hypothesized reallocation channels are not caused by the banks' sector market share or specialization, but instead by the specific type of the borrowers in those sectors where the banks have a higher market share or are more specialized.

H3 Firm risk: Banks that face a negative funding shock will transmit this shock depending on borrower characteristics.

2.3 Methodology

First, we analyze the average impact of a funding shock on bank credit supply. The average impact will serve as a baseline when focusing on the reallocation effect of the shock across sectors. The shock we exploit corresponds in timing with the collapse of the investment bank Lehman Brothers in September 2008 ("the shock"). As can be seen in Figure 1, the volume of interbank funding of banks active in Belgium severely dropped as of September 2008. Importantly, this world-wide interbank funding dry-up after the collapse of Lehman Brothers was exogenous to the Belgian credit market.

To analyze the average impact of the interbank funding shock on credit supply, we run a baseline regression of our three different credit growth measures (Credit_{bf}) on the bank funding shock, as well as on a number of bank controls and firm credit demand controls. In particular, we estimate the following equation:

$$\text{Credit}_{bf} = \beta_1\, \Delta\%\ \text{Interbank funding}_b + \delta\, \text{Bank controls}_b + \alpha_f + \epsilon_{bf}. \tag{3}$$

Subsequently, to analyze the within-bank heterogeneity in shock transmission, due to sector market share and specialization, we expand our baseline model with measures of bank sector market share and bank sector specialization and their interaction terms with the bank funding shock:

$$\begin{aligned}\text{Credit}_{bf} = {} & \beta_2\, \Delta\%\ \text{Interbank funding}_b * \text{Sector market share}_{bs} \\ & + \beta_3\, \Delta\%\ \text{Interbank funding}_b * \text{Sector specialization}_{bs} \\ & + \theta_1\, \text{Sector market share}_{bs} + \theta_2\, \text{Sector specialization}_{bs} + \alpha_f + \upsilon_b + \epsilon_{bf}.\end{aligned} \tag{4}$$

We control for bank-specific characteristics in both regression models, albeit differently. When analyzing the average impact of the funding shock [Equation (3)] we add a set of bank-specific control variables that capture banks' pre-crisis characteristics. We consider banks' reliance on interbank funding, bank capitalization, bank profitability, credit risk, liquidity ratio, stable deposit funding, and bank size. An attractive feature of the market share and the specialization measure in Equation (4) is that they vary at the bank-sector level. This allows us to control for observed and unobserved bank-specific heterogeneity by including bank-fixed effects (υ_b). We cannot do that when studying the average effect in Equation (3) as they would subsume the funding shock.

Next to including the funding shock and bank-specific controls, we control for observed and unobserved firm heterogeneity (including changes in firm-specific credit demand). In our most conservative setup, we do this by means of a set of firm-fixed effects, α_f. As such, we isolate credit supply by investigating how banks with different degrees of funding outflow changed their lending toward the same firm. The disadvantage of this setup is that one can only include firms that have at least two bank relationships. This disadvantage is sizable given that 84% of the firms in Belgium borrow from only one bank. As such, including firm-fixed effects substantially reduces the sample size and might create biased results if the multiple borrowers have vastly different characteristics than other borrowers. Therefore, we also report results for a sample that entails the full set of bank–firm pairs and use a firm-cluster-fixed effect to control for credit demand in this setup. The single bank firms are grouped according to the deciles of loan size in the credit register, the two-digit NACE code and the two-digit postal code (which broadly coincides with the district level). A similar approach is used by Edgerton (2012), Degryse et al. (2019), and Morais, Peydro, and Ruiz Ortega (Forthcoming). In case of a firm with multiple bank relationships, the cluster is defined as the firm itself. In Section 4.1, we explicitly discuss the (dis)advantages of both setups and show that firm-cluster-fixed effects are well suited to control for firm demand.

We expect that banks facing severe interbank funding outflows will need to reduce their credit supply relative to banks with no interbank funding outflow. Hence, in Equation (3), we expect $\beta_1 > 0$ in regressions with $\Delta\%$ Credit_{bf} or Increase in credit_{bf} as dependent variable; and $\beta_1 < 0$ in regressions with Large decrease in credit_{bf} as dependent variable.

Based on hypotheses 1 and 2, we expect that banks facing severe interbank funding outflows will try to shield borrowers that operate in sectors where the bank has a larger market share or where the bank has a larger sector specialization from the reduction in credit supply. Hence, in Equation (4), we expect $\beta_2 < 0$ and $\beta_3 < 0$ in regressions with $\Delta\%$ Credit_{bf} or Increase in credit_{bf} as dependent variable; and $\beta_2 > 0$ and $\beta_3 > 0$ in regressions with Large decrease in credit_{bf} as dependent variable.

In order to investigate reallocation effects due to firm riskiness, we also expand Equation (4) with interaction terms between the funding shock and five firm characteristics:

$$\begin{aligned}\text{Credit}_{bf} = {} & \beta_2\,\Delta\%\,\text{Interbank funding}_b * \text{Sector market share}_{bs} \\ & + \beta_3\,\Delta\%\,\text{Interbank funding}_b * \text{Sector specialization}_{bs} \\ & + \sum_{x=1}^{5}\beta_{x+3}\,\Delta\%\,\text{Interbank funding}_b * \text{Firm Variable}_f^x \\ & + \theta_1\,\text{Sector market share}_{bs} + \theta_2\,\text{Sector specialization}_{bs} + \alpha_f + \upsilon_b + \epsilon_{bf}.\end{aligned} \tag{5}$$

More specifically, we proxy for firm size, firm age, leverage, pledged collateral, and financial pressure. We thus test if banks that faced a funding shock after the Lehman collapse transmitted the shock differently to their smaller, younger, and/or riskier borrowers, while simultaneously shielding borrowers in sectors where they are more present or more specialized. Including these interactions also ensures that our sector reallocation results are not driven by (risk related) firm-level reallocation effects.

If banks facing severe interbank funding outflows would shield their larger, older, and safer borrowers from the reduction in credit supply, we expect $\beta_4 < 0$, $\beta_5 < 0$, and $\beta_6 > 0$, $\beta_7 > 0$, $\beta_8 > 0$ in regressions with $\Delta\%$ Credit_{bf} or Increase in credit_{bf} as dependent variable; and opposite signs in regressions with Large decrease in credit_{bf} as dependent variable.

Table IV. Average effect of an interbank funding shock on credit supply

This table shows the effect of a shock to interbank funding (Δ% Interbank funding$_b$) on credit growth at the bank–firm level, while controlling for time-averaged (over the 13 months preceding the shock) bank level covariates. The dependent variable is percentage growth in the granted loan amount (Column 1), a dummy variable that is 1 if the granted amount increases and zero otherwise (Column 2), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Column 3). For each of the measures, we first time-average the bank–firm exposure in the 13 months prior to the Lehman collapse as well as the 13 months following the Lehman collapse. We subsequently compute logarithmic growth rates of the pre- versus post-Lehman time-averaged loan amounts. The independent variable of interest is the change in interbank funding scaled by total assets. More specifically, it is the average value of interbank funding in the 13 months post-Lehman minus the average value in the 13 months prior to the Lehman collapse, scaled by the average value of total assets over the 13 months preceding 2008: 09. The table consists of two panels. Panel A reports the results for specifications with the full sample, where we control for firm demand using firm cluster FE. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Panel B reports the results for specifications with the sample of firms borrowing from multiple banks only in which case we control for firm demand using firm FE. Bank control variables are included in both panels, but not reported in Panel B. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Panel A: Full sample	(1) Δ% Credit$_{bf}$	(2) Increase in credit$_{bf}$	(3) Large decrease in credit$_{bf}$
Δ% Interbank funding$_b$	0.414***	0.586*	−0.877***
	(0.121)	(0.330)	(0.174)
Capital-to-total assets$_b$	−0.081	−0.228	0.224
	(0.194)	(0.443)	(0.233)
Return on equity$_b$	−0.074	−0.072	0.151
	(0.056)	(0.110)	(0.092)
Credit risk$_b$	0.509***	0.646**	−0.853***
	(0.117)	(0.301)	(0.166)
Liquidity ratio$_b$	0.078	−0.045	−0.243*
	(0.070)	(0.161)	(0.122)
Deposits to total assets$_b$	−0.078	−0.309	0.051
	(0.087)	(0.212)	(0.132)
Interbank funding to total assets$_b$	−0.057	−0.219	0.007
	(0.086)	(0.185)	(0.112)
Bank size$_b$	−0.007	−0.009	0.025**
	(0.006)	(0.013)	(0.009)
Firm cluster FE	Yes	Yes	Yes
Observations	160,223	160,223	160,223
R-squared	0.295	0.276	0.290

Panel B: Multiple-bank borrowers sample	(1) Δ% Credit$_{bf}$	(2) Increase in credit$_{bf}$	(3) Large decrease in credit$_{bf}$
Δ% Interbank funding$_b$	0.438***	0.597**	−0.630***
	(0.129)	(0.260)	(0.204)
Bank controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	47,205	47,205	47,205
R-squared	0.455	0.463	0.481

3. Empirical Results

3.1 Average Impact of the Funding Shock

We first analyze the average impact of the interbank funding shock on credit supply. Table IV presents the results using the three different credit growth indicators as dependent variable and consists of two panels. In the upper panel, we present the results for the full sample of firms, while controlling for firm demand by including firm-cluster-fixed effects. The sample consists of 160,223 observations from 117,166 firms borrowing from thirty-eight banks and grouped together in 34,639 firm clusters. We find that the funding shock has a statistically significant effect on credit availability in each of the three specifications. Firms borrowing from banks facing a larger funding outflow will face a tighter credit supply, reflected by a lower credit growth (Column 1), a lower likelihood of seeing an increase in their granted loan amount (Column 2) and a higher likelihood to experience a large drop in the granted loan amount (Column 3). Overall, bank funding shocks play a significant role for the credit extension to firms operating in Belgium.

What does a point estimate of 0.414 in Column 1 of Table IV imply in economic terms? The total amount of granted credit prior to the shock to all firms in the sample is EUR 100 billion. The average firm's bank experiences a funding shock of −10.3%. A point estimate of 0.414 thus implies that the average firm's supply-induced drop in credit is −4.26%.[15] Our results thus indicate that the supply-shock induced "missing credit" in the Belgian credit market is EUR 4.2 billion. The other coefficients can be interpreted as changes in probabilities. A firm borrowing from a bank hit by a funding shock of −10.3% has a 6.04 percentage points lower probability of seeing an increase in granted credit (sample mean is 28.9%) and a 9.03 percentage points higher probability of seeing a large decrease in granted credit (sample mean is 25%, by construction).

One, potentially crucial, difference with the common practice in the literature on bank funding shocks is the set of fixed effects we include. In the aforementioned results, we control for credit demand by including firm-cluster-fixed effects. In Panel B of Table IV we document the robustness of our results when using the smaller sample of multiple bank-relationship firms using firm-fixed effects. This subsample of firms borrowing simultaneously from multiple banks consists of 47,205 observations covering 21,349 firms. When focusing on the smaller sample of multiple bank borrowers, we find results that are qualitatively and quantitatively similar to the results in panel A of Table IV. The funding shock has a statistically significant effect on all three credit growth indicators and the coefficients have a similar magnitude as in the full sample.

3.2 Bank Funding Shocks and Credit Reallocation

3.2.a. Bank sector market share and bank sector specialization

Table V documents the reallocation of credit across sectors after the funding shock. As in the previous section, we report two sets of results. Panel A shows the results for the full sample of firms. In this panel, we control for firm demand by means of firm-cluster-fixed effects. Panel B shows the results for the subsample of firms that borrow from more than one bank. In this sample, we include firm-fixed effects. In addition, in the specifications

15 The 250 billion decrease in interbank funding was mainly absorbed by a large drop in interbank assets of slightly more than 200 billion. Another major shock absorber that insulated the Belgian corporate market was the reduction in cross-border lending (slightly less than 40 billion).

testing the reallocation channels, we can also include bank-fixed effects as the funding shock is interacted with measures computed at the bank-sector level.

The results in Panel A of Table V first of all show that the pass-through of the funding shock is less severe in sectors where the bank has a large market share. Focusing on the actual growth of granted credit (Column 1), the coefficient of the interaction term between the funding shock and sector market share is negative and significant, indicating that banks shield firms in sectors in which they have a larger market share. The impact is also economically important. For example, the point estimates in the first column imply that a one standard deviation increase in sector market share (0.084, see Table II) reduces the negative impact on credit growth of the average funding shock from 4.26 to 3.37% (i.e., a reduction of 0.89 percentage points or 20%).[16] Similarly, the second and third columns illustrate that the impact of a negative funding shock on the probability of increasing granted credit (Column 2) or having a large drop in granted credit (Column 3) is less severe for firms operating in sectors where the bank has a larger market share. A one standard deviation increase in sector market share reduces the negative impact of the average funding shock on the probability of seeing an increase (large decrease) in granted credit by 29% (15%).

Apart from sector market share, sector specialization also plays an important role for the pass-through of bank funding shocks. Our results indicate that, after a negative funding shock, credit growth is less affected in sectors that make up a relatively larger share of a bank's portfolio. More precisely, the results in the first column of Table V imply that a one standard deviation increase in sector specialization (0.083) reduces the negative impact of a 10.3% reduction in bank funding from 4.26% to 4.07% (i.e., a reduction in impact of 0.19 percentage points or 4%). The impact of sector specialization on the probability of increasing granted credit (Column 2) and on the probability of a large drop in granted credit (Column 3) confirms that banks reallocate credit after a funding shock toward firms operating in sectors in which the bank is specialized. A one standard deviation increase in sector specialization reduces the negative impact of the average funding shock on the probability of seeing an increase (large decrease) in granted credit by 5% (8%).

Panel B of Table V reports the results for the sample of firms that borrow from more than one bank. In this sample, we can control for firm demand by means of firm-fixed effects. In general, the results in this sample go in the same direction as the ones in the full sample, have the same economic magnitude, but become somewhat less precise.[17] Further tests in Section 4.1 indicate that this drop in precision is unlikely to be driven by the improvement in demand controls in this sample, but are rather a consequence of the sample specificities of multiple-bank vs. single-bank borrowers. Before digging deeper into this issue, we first examine whether firm characteristics also lead to reallocation effects. Overall, the results in Table V indicate that sector market share and specialization matter for the pass-through of bank funding shocks to firms. Banks prefer to shield firms in sectors

16 The impact of a 10.3% reduction is based on the results in Table IV: $-10.3\% * 0.414 = -4.26\%$. Based on the results in Table V, a one standard deviation increase in sector market share of 0.084 leads to an impact of $-10.3\% * (0.414 - 1.029 * 0.084) = -3.37\%$.

17 A one standard deviation increase in sector market share in Columns 1, 2, and 3 in Panel B of Table V leads to an estimated average mitigation of the credit contraction caused by a 10% funding shock of 30%, 20%, and 16% respectively. Similarly, the estimated average mitigation due to a one standard deviation increase in sector specialization is 4%, 11%, and 16% in Columns 1, 2, and 3, respectively of Panel B of Table V.

Table V. Within bank credit reallocation according to sector market share and sector specialization

This table contains information on the estimated effect of interbank funding shock (Δ% IBF_b) on credit supply, conditional on banks' sector market share and sector specialization. The dependent variable is percentage growth in the granted loan amount (Column 1), a dummy variable that is 1 if the granted amount increases and zero otherwise (Column 2), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Column 3). The independent variables of interest are the interaction between bank sector market share and sector specialization and the interbank funding shock. Panel A reports the results for specifications with the full sample, where we control for firm demand using firm cluster FE. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Panel B reports the results for specifications with the sample of firms borrowing from multiple banks only where we control for firm demand using firm-fixed effects. We control for all observed and unobserved bank-specific covariates by including bank-fixed effects. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Panel A: Full sample	(1) Δ% $Credit_{bf}$	(2) Increase in $credit_{bf}$	(3) Large decrease in $credit_{bf}$
Δ% IBF_b * sector market $share_{bs}$	−1.029***	−2.056***	1.599***
	(0.309)	(0.455)	(0.436)
Δ% IBF_b * Sector $specialization_{bs}$	−0.218*	−0.374	0.874***
	(0.115)	(0.349)	(0.178)
Sector market $share_{bs}$	−0.114**	−0.299***	0.246***
	(0.052)	(0.099)	(0.054)
Sector $specialization_{bs}$	0.007	0.103	−0.045
	(0.037)	(0.081)	(0.048)
Bank FE	Yes	Yes	Yes
Firm cluster FE	Yes	Yes	Yes
Observations	160,223	160,223	160,223
R-squared	0.298	0.282	0.292

Panel B: Multiple-bank borrowers sample	(1) Δ% $Credit_{bf}$	(2) Increase in $credit_{bf}$	(3) Large decrease in $credit_{bf}$
Δ% IBF_b * Sector market $share_{bs}$	−1.589***	−1.456**	1.235
	(0.571)	(0.581)	(1.088)
Δ% IBF_b * Sector $specialization_{bs}$	−0.190	−0.783*	1.239***
	(0.268)	(0.413)	(0.439)
Sector market $share_{bs}$	−0.164*	−0.162	0.183
	(0.082)	(0.113)	(0.164)
Sector $specialization_{bs}$	0.00446	0.0434	−0.126
	(0.058)	(0.101)	(0.118)
Bank FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	47,205	47,205	47,205
R-squared	0.460	0.469	0.486

in which they have a larger market share or in which they are more specialized. The results shown in Table III provide empirical evidence for the economic channels at work (namely rent extraction and information advantages, respectively).

3.2.b. Firm risk

Both theoretical and empirical work has indicated that smaller firms (size), firms without track record (age) or firms with weaker balance sheets or less collateral (risk), are more likely to be financially constrained, due to asymmetric information between the bank and the firm. This holds in general and is expected to be particularly relevant during periods characterized by adverse economic shocks (e.g., tight monetary policy, economic recession, banking crisis). If the degree of bank sector market share or specialization is correlated with the characteristics of firms that banks lend to, it might be that the above-documented reallocation channel is not caused by the banks' market share or specialization, but instead by the specific type of the borrowers in those sectors where the banks are more present or specialized. In this section, we exploit the heterogeneity in firm characteristics to explore whether banks differentially transmit a funding shock to firms in excess of the reallocation due to bank sector market share and specialization.

We consider five firm characteristics. We proxy for firm size, age, leverage, collateral availability, and financial pressure. We thus test if banks that faced a funding shock after the Lehman collapse transmitted the shock more to their smaller, younger, and or riskier borrowers, while simultaneously shielding borrowers in sectors where they are more present or more specialized.

The results in Panels A and B of Table VI indicate that banks reallocate credit to safer firms. A low leverage ratio, a low amount of already pledged collateral, and a low ratio of interest payments over earnings all shield firms from the transmission of the funding shock. These reallocation effects are not only statistically, but also economically significant. Focusing on the full-sample results, a one standard deviation decrease in the leverage ratio, in the ratio of pledged collateral to fixed assets, or in the ratio of interest payments over earnings reduces the negative impact on credit supply of a 10.3% reduction in bank funding by 11%, 6%, or 12%, respectively. A change in risk characteristics thus has a mitigating effect that is roughly equal in magnitude compared with sector specialization.

The results in Table VI also show that the sector reallocation documented in Section 3.2.1 is still present after taking into account heterogeneity in the shock transmission according to firm risk. Banks still reallocate credit toward sectors in which they are more present and toward sectors in which they are more specialized, over and above reallocating credit toward safer firms. Hence, it ensures that our sector reallocation results are not driven by (risk related) firm-level reallocation effects. It also alleviates the concern that our sector reallocation findings could be driven by characteristics that are typically rather sector-specific, such as having a high amount of collateral.

Finally, we do not find evidence that banks transmit liquidity shocks more to small firms or to young firms. The interaction of the funding shock with firm size and age is not significant, independent of the demand controls, which is in contrast with Khwaja and Mian (2008), Iyer et al. (2014), and Liberti and Sturgess (2018). A potential explanation is that small firms in Belgium have to report relatively detailed balance sheet information. As a consequence, asymmetric information problems between (small or young) firms and banks are potentially much lower in Belgium than in the other (emerging) countries investigated in the aforementioned papers.

Table VI. Heterogenous shock transmission: Sector market share, sector specialization, and the role of firm characteristics

This table shows the impact of an interbank funding shock (Δ% IBF_b) on credit supply, conditional on banks' sector market share, banks' sector specialization, and firm characteristics (firm size, firm age, leverage, pledged collateral to fixed assets, and financial pressure). We simultaneously include these variables and their interaction with the funding shock. The dependent variable is percentage growth in the granted loan amount (Column 1), a dummy variable that is 1 if the granted amount increases and zero otherwise (Column 2), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Column 3). Panel A reports the results for specifications with the full sample, where we control for firm demand using firm cluster FE. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Panel B reports the results for specifications with the sample of firms borrowing from multiple banks only where we control for firm demand using firm FE. We control for all observed and unobserved bank-specific covariates by including bank-fixed effects. Firm controls include all interacted firm characteristics. Bank-sector controls include bank sector market share and specialization. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

Panel A: Full sample	(1) Δ% $Credit_{bf}$	(2) Increase in $credit_{bf}$	(3) Large decrease in $credit_{bf}$
Δ% IBF_b * Sector market $share_{bs}$	−0.875***	−1.499***	1.137*
	(0.235)	(0.372)	(0.571)
Δ% IBF_b * Sector $specialization_{bs}$	−0.334**	−0.426	0.942***
	(0.146)	(0.343)	(0.213)
Δ% IBF_b * Total $assets_f$	0.016	0.008	−0.006
	(0.030)	(0.061)	(0.026)
Δ% IBF_b * Age_f	0.001	−0.007***	0.000
	(0.002)	(0.003)	(0.003)
Δ% IBF_b * $Leverage_f$	0.178***	0.405***	−0.224
	(0.048)	(0.136)	(0.167)
Δ% IBF_b * Pledged collateral to fixed $assets_f$	0.026**	0.029	−0.049**
	(0.010)	(0.021)	(0.020)
Δ% IBF_b * Financial $pressure_f$	0.061***	0.061**	−0.062***
	(0.016)	(0.030)	(0.020)
Firm and bank-sector controls	Yes	Yes	Yes
Bank FE and Firm cluster FE	Yes	Yes	Yes
Observations	141,762	141,762	141,762
R-squared	0.364	0.320	0.337

(continued)

Figure 2 graphically summarizes our main results. It shows the expected impact of a 10% interbank funding outflow on credit growth for a number of interesting scenarios, as predicted by our estimations reported in Tables IV and VI. We plot the expected average impact of such a funding shock, and also the expected effect for each combination of high/low bank sector market share and high/low bank sector specialization, as well as one addition with high/low firm leverage; where high (low) is defined as a the mean ± one standard

Table VI. Continued

Panel B: Multiple-bank borrowers sample	Δ% Credit_{bf}	Increase in credit_{bf}	Large decrease in credit_{bf}
Δ% IBF_b * Sector market share_{bs}	−1.429**	−0.454	1.346
	(0.653)	(0.818)	(1.548)
Δ% IBF_b * Sector $\text{specialization}_{bs}$	−0.355	−0.931*	1.261**
	(0.275)	(0.475)	(0.485)
Δ% IBF_b * Total assets_f	−0.007	−0.008	0.031
	(0.042)	(0.070)	(0.023)
Δ% IBF_b * Age_f	0.004	0.000	−0.003
	(0.002)	(0.002)	(0.003)
Δ% IBF_b * Leverage_f	0.335***	0.833***	−0.408**
	(0.090)	(0.300)	(0.181)
Δ% IBF_b * Pledged collateral to fixed assets_f	0.009	−0.014	−0.009
	(0.020)	(0.020)	(0.025)
Δ% IBF_b * Financial pressure_f	0.103***	0.097**	−0.090***
	(0.028)	(0.046)	(0.027)
Bank-sector controls	Yes	Yes	Yes
Bank FE and firm FE	Yes	Yes	Yes
Observations	44,904	44,904	44,904
R-squared	0.459	0.469	0.485

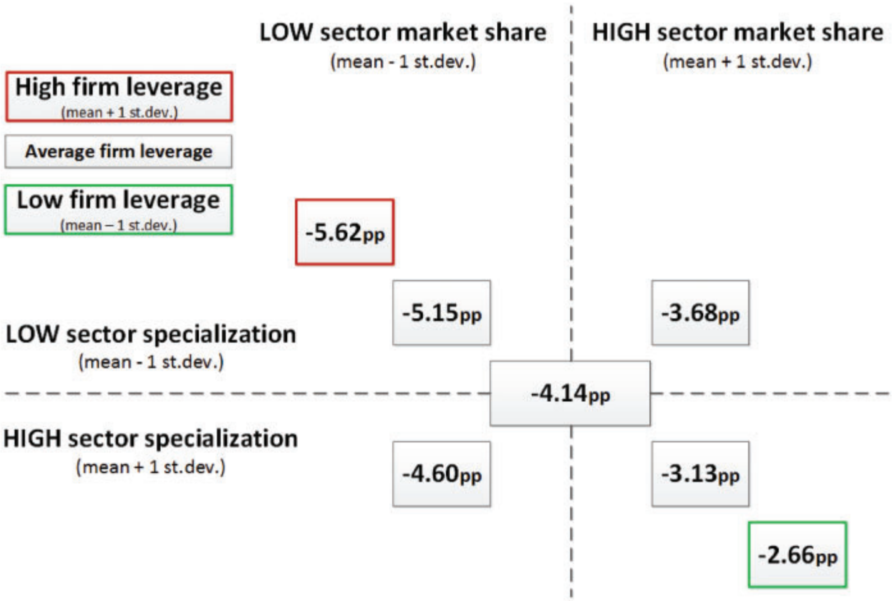

Figure 2. Heterogeneous impact of a 10% interbank funding outflow on credit growth.
This figure shows the expected impact of a 10% interbank funding outflow on credit growth for a number of interesting scenarios as predicted by our estimations. The figure plots the expected impact of a funding shock, but also the expected effect for each combination of high/low bank sector market share and high/low bank sector specialization, as well as one addition with high/low firm leverage as a firm risk proxy; where high (low) is defined as a the mean ± one standard deviation.

deviation. The transmission of the funding shock is more than twice as large for risky firms borrowing from banks that have a low market share and low specialization in the firms' sector (expected effect on credit growth of −5.62 percentage points) compared with safe firms borrowing from banks that have a high market share and high specialization in the firms' sector (expected effect on credit growth of only −2.66 percentage points).

4. Challenges to Identification

4.1 Demand Control versus Sample Composition

Tables IV, V, and VI presented results for the full sample of borrowers in Panel A and the subset of multiple bank borrowers in Panel B. In general, we observed that the results for the sample of multiple firms go in the same direction as the ones for the full sample, but they become less precise. This section shows that these less significant results are not driven by the (theoretical) improvement in credit demand controls, but are rather a consequence of the specificities of multiple bank *vis-à-vis* single bank borrowers.

Estimations on the sample of multiple bank borrowers allow for the inclusion of firm-fixed effects, which is the most conservative way to control for firm demand and is the current standard in the literature. However, it also implies that one can only use data for firms that borrow from more than one bank. The majority of firms in Belgium (84%) borrow from only one bank. Ignoring these firms leads to a number of concerns when it comes to testing our two main hypotheses. First of all, focusing on the small subgroup of multiple bank borrowers might bias our results if these firms are not representative for the full sample of borrowers. Multiple bank borrowers are indeed more likely to be larger and older firms than single bank borrowers (Degryse et al., 2019). More importantly, they also have substitutes available, which reduces the potency of the sector market share and sector specialization channels. Second, recent research by Degryse, Ioannidou, and von Schedvin (2016) shows that an outside loan (i.e., a loan from another bank) decreases a bank's willingness to lend to this firm. This, together with the prospect of potential coordination problems between lenders when a firm defaults might make it less attractive to shield multiple bank borrowers. Overall, we thus expect stronger results for the full sample than for the multiple bank borrower sample.

We run three additional tests to examine the importance of the trade-off between using the most appropriate sample to test our hypotheses and using the most appropriate set of fixed effects to control for credit demand. First, we run the baseline regression analyzing the average effect of the funding shock on the multiple bank borrower sample (as in Panel B of Table IV), but use firm cluster-fixed effects based on location-sector-size triples rather than firm-fixed effects (the results are reported in Panel A of Table VII). We do not find any difference for the average impact of the change in interbank funding on bank lending in the multiple bank borrower sample when using firm cluster or firm-fixed effects. This is a first indication that firm cluster-fixed effects reasonably capture firm credit demand.

Second, we also run a regression examining the reallocation channels on the sample of multiple bank borrowers, but use firm cluster-fixed effects based on location-sector-size triples rather than firm-fixed effects. Comparing the results with firm cluster-fixed effects (Panel B of Table VII) to the results with firm-fixed effects (Panel B of Table VI), we find that the realloaction coefficients are very similar (eight out of nine significant coefficients remain significant), which again indicates that firm cluster-fixed effects reasonably capture firm credit demand. Third, we run regressions on the subsample of single bank borrowers only (Panel C of Table VII) and find similar effects as in the full sample that are, if anything,

Table VII. The importance of demand control (firm-fixed effects vs. firm cluster-fixed effects) and sample composition (multiple-bank borrowers vs. single-bank borrowers)

This table shows the impact of an interbank funding shock ($\Delta\%$ IBF_b) on credit supply (Panel A) and the heterogenous impact conditional on banks' sector market share, banks' sector specialization, and firm characteristics (Panels B and C). Panels A and B report the results for specifications with the sample of multiple-bank borrowers only, whereas Panel C reports the results for specifications with the sample of single-bank borrowers only. Importantly, in all panels we control for firms' credit demand using firm cluster FE, where clusters are based on location-sector-size triplets. The dependent variable is percentage growth in the granted loan amount (Column 1), a dummy variable that is 1 if the granted amount increases and zero otherwise (Column 2), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Column 3). We include bank-fixed effects in Panels B and C. Firm controls include all interacted firm characteristics. Bank-sector controls include bank sector market share and specialization. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Panel A: Multiple-bank borrowers sample	(1) $\Delta\%$ $Credit_{bf}$	(2) Increase in $credit_{bf}$	(3) Large decrease in $credit_{bf}$
$\Delta\%$ IBF_b	0.417***	0.616*	−0.642***
	(0.142)	(0.321)	(0.201)
Bank controls	Yes	Yes	Yes
Firm cluster FE	Yes	Yes	Yes
Observations	44,904	44,904	44,904
R-squared	0.219	0.219	0.249
Panel B: Multiple-bank borrowers sample	**$\Delta\%$ $Credit_{bf}$**	**Increase in $credit_{bf}$**	**Large decrease in $credit_{bf}$**
$\Delta\%$ IBF_b * Sector market $share_{bs}$	−1.526***	−1.162	1.633
	(0.409)	(1.103)	(1.185)
$\Delta\%$ IBF_b * Sector $specialization_{bs}$	−0.081	−0.584	1.127**
	(0.298)	(0.501)	(0.496)
$\Delta\%$ IBF_b * Total $assets_f$	−0.002	−0.006	0.030
	(0.041)	(0.066)	(0.025)
$\Delta\%$ IBF_b * Age_f	0.002	−0.003	0.001
	(0.002)	(0.004)	(0.003)
$\Delta\%$ IBF_b * $Leverage_f$	0.270***	0.533**	−0.400*
	(0.098)	(0.229)	(0.228)
$\Delta\%$ IBF_b * Pledged collateral to fixed $assets_f$	0.020	0.010	−0.042
	(0.023)	(0.024)	(0.036)
$\Delta\%$ IBF_b * Financial $pressure_f$	0.110***	0.142***	−0.098***
	(0.023)	(0.039)	(0.031)
Firm and bank-sector controls	Yes	Yes	Yes
Firm cluster FE and bank FE	Yes	Yes	Yes
Observations	44,904	44,904	44,904
R-squared	0.244	0.236	0.265

(continued)

Table VII. Continued

Panel C: Single-bank borrowers sample	Δ% Credit$_{bf}$	Increase in credit$_{bf}$	Large decrease in credit$_{bf}$
Δ% IBF$_b$ * Sector market share$_{bs}$	−0.905***	−2.219***	1.268**
	(0.212)	(0.413)	(0.541)
Δ% IBF$_b$ * Sector specialization$_{bs}$	−0.372**	−0.362	0.808***
	(0.148)	(0.440)	(0.249)
Δ% IBF$_b$ * Total assets$_f$	0.006	0.017	−0.007
	(0.028)	(0.059)	(0.043)
Δ% IBF$_b$ * Age$_f$	−0.001	−0.010**	0.002
	(0.002)	(0.004)	(0.003)
Δ% IBF$_b$ * Leverage$_f$	0.138***	0.327**	−0.191
	(0.049)	(0.147)	(0.171)
Δ% IBF$_b$ * Pledged collateral to fixed assets$_f$	0.034**	0.052*	−0.069**
	(0.015)	(0.028)	(0.033)
Δ% IBF$_b$ * Financial pressure$_f$	0.053***	0.050	−0.057***
	(0.016)	(0.036)	(0.020)
Firm and bank-sector controls	Yes	Yes	Yes
Firm cluster FE and bank FE	Yes	Yes	Yes
Observations	96,855	96,855	96,855
R-squared	0.314	0.246	0.272

statistically more significant. All three tests thus indicate that the reduction in the precision of the coefficients in the multiple bank borrower sample is more likely driven by the specificities of the sample than by the appropriateness of the demand control.

4.2 Bank Solvency Concerns

A potential concern is that exposure to the US subprime crisis might have led to solvency problems at Belgian banks. If these exposures are correlated with our funding shock, this could bias our results. In this section, we therefore examine whether our results are biased due to pre-shock bank solvency issues. Short of a measure of the direct exposure to the US mortgage market, we construct a proxy as follows. For each Belgian bank, we have the exposure to three sectors (public sector, non-bank private sector, or banks) in a given country. We use the ultimate exposures to the US non-bank private sector and US banking sector to construct our solvency proxy.[18]

The exposure to the non-bank private sector can be seen as a proxy for exposure to US households. The exposure to the US banking sector allows us to control for two related solvency concerns. First, it allows us to proxy for the asset-side exposure to the ABCP market. Kacperczyk and Schnabl (2010), for example, document that asset-backed commercial

18 The granular data are the source data used to construct the BIS consolidated international banking statistics and is hence available on immediate and ultimate risk base. We use the ultimate exposures as they account for net risk transfers. For example, suppose that a Belgian bank extends a loan to a company based in Mexico and that the loan is guaranteed by a US bank. On an immediate risk basis, the exposure would be to Mexico. However, at the ultimate risk basis, the loan is regarded as a claim of a Belgian bank on the US banking sector since that is where the ultimate risk resides.

paper played a crucial role during the 2007–2009 crisis, and that more than 90% of this paper was issued by the financial sector. While ABCP was often issued by financial conduits owned by banks—and thus not directly by banks—Acharya, Schnabl, and Suarez (2013) show that a large part of the issuances was explicitly insured by the banks. As such, the ultimate exposure to the US banking sector should be a good proxy for the exposure to the ABCP market. Second, another main part of the exposure to banks are direct exposures to US banks. Given that a large part of the US banking sector was severely hit by the crisis [Huizinga and Laeven (2012), e.g., document that 60% of US bank holding companies had a market-to-book ratio of assets below 1 by the end of 2008], it is reasonable to expect that a high exposure to these banks could also lead to solvency concerns.

We calculate the sum of the ultimate exposure to US banks and to the US private sector for each month during our pre-period, and then take the average over this period. We scale this average exposure by a bank's average total assets over this period.

Panel A of Table VIII shows that the average impact of the funding shock is still significant when controlling for the exposure to the USA. Moreover, compared with the results in Table IV, the coefficients associated with the funding shock remain their sign and are of similar magnitude compared. Columns 1, 3, and 5 of Table VIII show the results for the full sample, while Columns 2, 4, and 6 show the results for the sample of multiple bank borrowers. The coefficient on the US exposure variable is negative and significant, implying that banks with a higher exposure did reduce credit more than other banks, which is in line with the expectation that the US exposure variable is a good proxy for solvency concerns.

Panel B of Table VIII shows that also our reallocation results still hold when adding the interaction terms between this solvency proxy and the banks' sector market share and specialization. Compared with the baseline results in Table V, there is only a slight reduction in coefficient size. The interaction terms that are significant in the baseline setup remain significant when adding the solvency proxy, with one exception being the interaction with sector market share in Column 4.

Table VIII around here in unreported regressions, we also use an alternative measure for solvency concerns, which is the outflow in corporate deposits. The outflow in corporate deposits proxies for the change in uninsured deposits, which should respond to solvency concerns (if any). Our findings are unaffected when using this alternative solvency concern measure.

4.3 Pre-shock Liquidity Events

Our next test addresses a potential bias due to pre-Lehman liquidity issues. Even when banks had no direct asset-side exposure to the ABCP market, the 2007 crisis in this market might have affected their funding conditions. Existing studies such as Iyer et al. (2014) and Ippolito et al. (2016) observe that the interbank funding of Portuguese, respectively, Italian, banks dropped due to the ABCP crisis. They also show that this interbank shock impacted bank credit supply (Portugal) or drawdowns on existing credit lines (Italy). In line with these papers, we redo our analysis and now take 2006:6–2007:7 as pre-period and 2007:7–2008:8 as post-period. The results are reported in Table IX.

In contrast to Iyer et al. (2014) and Ippolito et al. (2016), we do not find that the change in interbank funding around July 2007 is statistically significantly related to credit supply (none of the three measures); neither for the full sample (Panel A of Table IX) nor for the multiple bank borrower sample (Panel B of Table IX). In addition, we do not find support

Table VIII. Robustness on pre-shock confounding events: potential solvency issues

This table shows the effect of a shock to interbank funding (Δ% IBF_b) on credit growth at the bank–firm level, while controlling for solvency concerns. Our proxy for solvency concerns is a bank's exposure to the US housing and mortgage market. US $exposure_b$ is constructed using monthly bank-level data used to construct the BIS-consolidated international banking statistics. More specifically, we take the average ultimate risk exposures to the US non-bank private sector and US banking sector pre-shock, scaled by average total assets pre-shock. The dependent variable is percentage growth in the granted loan amount (Columns 1 and 2), a dummy variable that is 1 if the granted amount increases and zero otherwise (Columns 3 and 4), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Columns 5 and 6). Panel A shows the results for the average impact of the funding shock on bank lending when controlling for banks' exposure to the US housing and mortgage market. Panel B shows the reallocation results when controlling for potential reallocation effects due to banks' exposure to the US housing and mortgage market. We report the results for specifications with the full sample where we control for firm demand using firm cluster FE (Columns 1, 3, and 5) and for the sample of firms borrowing from multiple banks where we control for firm demand using firm FE (Columns 2, 4, and 6). In the full sample, firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Bank controls include bank capitalization, profitability, credit risk, liquidity, stable deposit funding, and size. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	Δ% $Credit_{bf}$		Increase in $credit_{bf}$		Large decrease in $credit_{bf}$	
Δ% IBF_b	0.379***	0.484***	0.538*	0.641**	−0.816***	−0.705***
	(0.096)	(0.113)	(0.289)	(0.253)	(0.120)	(0.163)
US $exposure_b$	−0.560***	−0.573***	−0.782**	−0.545*	1.001***	0.921***
	(0.139)	(0.135)	(0.370)	(0.298)	(0.162)	(0.196)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm cluster FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	160,223	47,205	160,223	47,205	160,223	47,205
R-squared	0.296	0.456	0.277	0.464	0.291	0.482
Panel B	Δ% $Credit_{bf}$		Increase in $credit_{bf}$		Large decrease in $credit_{bf}$	
Δ% IBF_b	−0.872**	−1.143*	−1.656***	−0.746	1.582***	0.806
* Sector market $share_{bs}$	(0.335)	(0.667)	(0.537)	(0.540)	(0.463)	(1.210)
Δ% IBF_b	−0.253*	−0.404	−0.479	−1.171***	0.880***	1.381***
* Sector $specialization_{bs}$	(0.133)	(0.336)	(0.372)	(0.419)	(0.173)	(0.490)
US $exposure_b$	1.327	2.835	2.317	2.897	0.026	−5.017
* Sector market $share_{bs}$	(2.787)	(3.216)	(3.907)	(4.372)	(3.359)	(4.041)
US $exposure_b$	0.767	1.822*	2.469	3.422**	−0.172	−1.028
* Sector $specialization_{bs}$	(0.782)	(0.928)	(1.520)	(1.427)	(0.844)	(0.935)
R-squared	0.298	0.460	0.282	0.469	0.292	0.486
Bank-sector controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm cluster FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	160,223	47,205	160,223	47,205	160,223	47,205

for the reallocation channels in this period. These results are not surprising as Figure 1 indicates that the interbank funding of Belgian banks was not yet impaired prior to Lehman. The figure shows that funding was still growing, though slightly more volatile, after July 2007 and (nearly) peaked around the Lehman collapse. In addition, given the resilience of Belgian banks to the interbank funding turmoil in the summer of 2007, the results in Table IX could also be seen as a placebo test and are as such also reassuring for the choice of our event window.

In sum, we can be confident that our results are not affected by pre-Lehman interbank market liquidity concerns.

4.4 Post-shock Confounding Events

The largest banks operating in Belgium experienced the largest interbank funding shock, but are at the same time also the most internationally active. One concern could be that the choices they make in their Belgian portfolio are not independent from their cross-border portfolio choices. Furthermore, some of these large banks received government bail-outs, which might raise concerns on whether or not these interventions could have affected banks' lending policies. Both concerns imply that our results might be contaminated or driven by factors that correlate with bank size, other than the interbank funding shock. In this section, we show that these potentially confounding events are not driving our results.

We start by investigating the role of the adjustments in the foreign corporate lending market. An ideal scenario would be that we have information on cross-border loans on a bank–firm basis or bank-sectoral level. This would allow us to analyze whether banks adjust the Belgian portfolio according to cross-border sector market share and specialization or vice versa. Unfortunately, such data are not available. The second best is to obtain data on the total volume of cross-border lending by bank on a monthly basis. We collect these data from the regulatory balance sheet filings of the banks and use it to run additional tests.

We use the pre-shock share of cross-border lending in total lending, and analyze whether having large cross-border lending operations affects credit reallocation (similar to Table V).[19] Compared with the baseline specification (see Table IV), we find a similar effect of the interbank funding shock on credit supply in Belgium when the pre-shock share of cross-border lending is included (as can be seen in Panel A of Table X). In terms of credit reallocation in response to the interbank funding shock, there is hardly any effect on the magnitudes of the point estimates of the reallocation channels compared with a specification without these additional cross-border lending interaction terms (panel B of Table X versus Table V).

Next, one might be concerned that the various government interventions may have come with some (to us unobservable) strings attached for the banks. Anecdotal evidence on the bail-outs during our sample period indicates that governments were almost exclusively occupied with avoiding a total collapse of the banking sector and restoring confidence of the public in the banking sector. We also found no indications in either the media, government sources, banks' annual reports, nor from informal inquiries with bank supervisors

19 We use the pre-shock share of cross-border lending and not the actual change in cross-border lending given that the latter is jointly determined with the change in domestic lending. In unreported results, we observe a positive and significant relationship between the change in interbank funding and the change in cross-border lending. Moreover, this relations is stronger for banks with a relatively higher share of cross-border loans in their loan portfolio.

Table IX. Robustness on pre-shock confounding events: Potential liquidity issues surrounding the ABCP shock in July 2007

This table shows the effect of a shock to interbank funding ($\Delta\%$ IBF_b) on credit growth at the bank–firm level, assuming that the shock took place in July 2007 (i.e., the start of the ABCP crisis). The pre-shock period consists of the 13 months prior to the ABCP shock (2006:7–2007:7) and the post-shock period consists of the 13 months after to the ABCP shock (2007:8–2008:8) and thus stops right before the Lehman collapse. The table shows both the average effect (Columns 1, 3, and 5) and heterogenous effect based on banks' sector market share and sector specialization (Columns 2, 4, and 6). The dependent variable is percentage growth in the granted loan amount (Columns 1 and 2), a dummy variable that is 1 if the granted amount increases and zero otherwise (Columns 3 and 4), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Columns 5 and 6). Panel A reports the results for specifications with the full sample, where we control for firm demand using firm cluster FE. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Panel B reports the results for specifications with the sample of firms borrowing from multiple banks only where we control for firm demand using firm FE. Bank controls include bank capitalization, profitability, credit risk, liquidity, stable deposit funding, and size. Bank-sector controls include bank sector market share and specialization. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

Panel A: Full sample	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta\%$ Credit$_{bf}$		Increase in credit$_{bf}$		Large decrease in credit$_{bf}$	
$\Delta\%$ IBF_b	−0.163		−0.199		−0.009	
	(0.098)		(0.215)		(0.126)	
$\Delta\%$ IBF_b * Sector market share$_{bs}$		−0.365		−1.114		0.565
		(0.421)		(0.710)		(1.042)
$\Delta\%$ IBF_b * Sector specialization$_{bs}$		0.004		−0.050		0.489**
		(0.182)		(0.322)		(0.233)
Bank controls	Yes	No	Yes	No	Yes	No
Bank-sector controls	No	Yes	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes	No	Yes
Firm cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	153,854	153,854	153,854	153,854	153,854	153,854
R-squared	0.309	0.312	0.289	0.298	0.290	0.293
Shock timing	2007/07	2007/07	2007/07	2007/07	2007/07	2007/07

(continued)

and bank sector representatives that there would have been political pressure on banks to particularly keep lending where the bank has more market power or is more specialized. However, it is still important to clearly spell out how these interventions might impact our results.[20]

One concern could be that (i) government interventions are strongly correlated with our interbank funding shock and that (iia) these banks were forced to keep lending or (iib) saw

20 We add a description of the guarantees and capital injections received by the large Belgian banks in the Online Appendix, Section A1.

Table IX. Continued

Panel B: Multiple-bank borrowers sample	(1) Δ% $Credit_{bf}$	(2)	(3) Increase in $credit_{bf}$	(4)	(5) Large decrease in $credit_{bf}$	(6)
Δ% IBF_b	−0.027		0.069		−0.010	
	(0.114)		(0.189)		(0.151)	
Δ% IBF_b * Sector market $share_{bs}$		−0.749		−2.766		−0.185
		(0.866)		(1.926)		(1.191)
Δ% IBF_b * Sector $specialization_{bs}$		0.559		0.646		−0.055
		(0.351)		(0.777)		(0.443)
Bank controls	Yes	No	Yes	No	Yes	No
Bank-sector controls	No	Yes	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45,905	45,905	45,905	45,905	45,905	45,905
R-squared	0.460	0.464	0.475	0.485	0.477	0.482
Shock timing	2007/07	2007/07	2007/07	2007/07	2007/07	2007/07

a smaller funding outflow than would have been the case without bailout. It is indeed the case that there is a relatively strong correlation between government interventions and our funding shock measure: We find a correlation of −0.41 between a government intervention dummy and the percentage change in interbank funding at the bank level. Now, if either scenario (iia) or (iib) is also true (which we cannot observe), then our estimates reported in Table IV are potentially underestimating the true effect and thus provide a lower bound for the impact of funding shocks.

A more complicated scenario would be that (i) government interventions are strongly correlated with our interbank funding shock and (ii) the government pushes the bank to keep lending exactly in the sectors where that bank is most specialized and/or has a larger market share. Again point (ii) is less straightforward and much more difficult to check. In order to show that our results are driven by a funding shock, rather than by interventions, we set up a robustness test that focuses on a funding shock that is far less correlated with government interventions: Deposit flows. The correlation between a bailout dummy and the change in deposit funding in our bank sample is only −0.20 (versus −0.41 for the interbank funding shock). Even more important, while two of the banks which received government support in our sample experienced a strong drop in deposits after the Lehman collapse, the two other that received government support effectively experienced an inflow of deposits. Two large banks thus faced a bank-run on their deposits (on top of the interbank funding dry-up),[21] and a large portion of these deposits were deposited at the other banks (including the two other large banks). This automatically makes it less plausible that any results obtained using this deposit shock are driven by bailouts. Table XI shows the results when using a deposit shock instead of an interbank funding shock.

21 The outflow in deposits at these two banks was substantial and amounted to −11% (−4.2%) and −13% (−3.6%) of their total lending (assets).

Table X. Robustness on post-shock confounding events: potential impact of cross-border lending

This table shows the effect of a shock to interbank funding ($\Delta\%$ IBF_b) on credit growth at the bank–firm level, while controlling for the bank's pre-shock cross-border corporate lending share. The dependent variable is percentage growth in the granted loan amount (Columns 1 and 2), a dummy variable that is 1 if the granted amount increases and zero otherwise (Columns 3 and 4), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Columns 5 and 6). Panel A shows the results for the average impact of the funding shock on bank lending when controlling for a bank's pre-shock cross-border corporate lending share. Panel B shows the reallocation results when controlling for potential reallocation effects depending on bank's pre-shock cross-border corporate lending share. We report the results for specifications with the full sample where we control for firm demand using firm cluster-fixed effects (Columns 1, 3, and 5) and for the sample of firms borrowing from multiple banks where we control for firm demand using firm-fixed effects (Columns 2, 4, and 6). In the full sample, firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Bank controls include bank capitalization, profitability, credit risk, liquidity, stable deposit funding, and size. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	$\Delta\%$ Credit$_{bf}$		Increase in credit$_{bf}$		Large decrease in credit$_{bf}$	
$\Delta\%$ IBF$_b$	0.423***	0.430***	0.614*	0.585**	−0.861***	−0.648***
	(0.116)	(0.139)	(0.321)	(0.273)	(0.170)	(0.215)
Cross-border lending$_b$	0.059	0.029	0.166	0.049	0.099	0.071
	(0.048)	(0.069)	(0.110)	(0.114)	(0.063)	(0.088)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm cluster FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	160,223	47,205	160,223	47,205	160,223	47,205
R-squared	0.295	0.455	0.276	0.463	0.290	0.481
Panel B	$\Delta\%$ Credit$_{bf}$		Increase in credit$_{bf}$		Large decrease in credit$_{bf}$	
$\Delta\%$ IBF$_b$	−0.920***	−1.357**	−1.830***	−1.032**	1.584***	1.015
* Sector market share$_{bs}$	(0.314)	(0.549)	(0.454)	(0.506)	(0.341)	(0.734)
$\Delta\%$ IBF$_b$	−0.217*	−0.227	−0.413	−0.902**	0.806***	1.123**
* Sector specialization$_{bs}$	(0.124)	(0.265)	(0.364)	(0.389)	(0.197)	(0.451)
Cross-border lending$_b$	−1.132	−1.957	−0.680	−2.296	2.991**	5.580***
* Sector market share$_{bs}$	(0.957)	(1.429)	(1.310)	(2.037)	(1.328)	(2.016)
Cross-border lending$_b$	0.426**	0.471**	0.763*	0.905**	−0.266	−0.318
* Sector specialization$_{bs}$	(0.163)	(0.215)	(0.426)	(0.442)	(0.306)	(0.297)
Bank-sector controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm cluster FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	160,223	47,205	160,223	47,205	160,223	47,205
R-squared	0.298	0.460	0.282	0.469	0.292	0.486

Table XI documents that the reallocation effects are similar when using the change in deposits rather than the change in interbank funding as the shock. In fact, the statistical significance as well as the economic magnitude are even slightly stronger, indicating that, if anything, government support might be working against finding support for our hypotheses. Our hypotheses are based on the profit-maximizing behavior of banks. At the same time, there exists convincing empirical evidence that government-owned or -intervened banks behave in a non-profit maximizing way, shaping bank outcomes such as lending [see, e.g., Sapienza (2004), Dinc (2005), Bian et al. (2017)]. If government support comes with strings attached (e.g., forced lending to certain sectors), this would thus most likely not be with the idea of maximizing bank profitability in mind, which works against our hypotheses and would thus make it harder for us to find significant results.

4.5 Further Robustness

We subsequently ensure that our main reallocation results are not driven by other potential reallocation effects or by underlying bank–firm-specific relation characteristics.

A first important concern might stem from the existing literature on relationship lending (see, e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; Boot, 2000; Degryse and Ongena, 2005; Bolton et al., 2016). Throughout the lending process, banks can gather firm-specific soft information (e.g., management quality), through repeated contacts, which is difficult to observe for outsiders. Especially banks with market power might be more likely to engage in relationship lending (Petersen and Rajan, 1995). This information advantage can allow a bank to extract monopoly rents [see, e.g., Sharpe (1990) or Rajan (1992)]. If banks want to shield these rents and if at the same time banks are more likely to have better firm-specific information in sectors in which they have a strong sector market share or where they are specialized, then our main results might be driven by this firm-specific information advantage. Therefore, we add two widely used relationship lending proxies to our setup. We include the length of a bank–firm relationship, measured by the number of months that a firm has been borrowing from a bank before September 2008. We also add a dummy which is equal to 1 if the bank is the main bank of the firm, and equal to zero otherwise, where the main bank is defined as the bank with the largest share in the total amount granted to a firm.

Another important concern could be that our main sector reallocation results are merely picking up other types of bank portfolio choices that happen to be related with sector choices. Two examples of such choices are geographical bank specialization or loan maturity specialization. Some banks might be coincidentally specialized in a sector because this sector is over-represented in the area in which the bank is doing business. Similarly, a bank might be coincidentally specialized in a sector because firms in that sector mainly need short-term credit, and the bank happens to be specialized in providing that type of credit. Additionally, short-term credit might be easier to cut (or not rolled over). If sector specialization is correlated with the share of short-term lending, we could be picking up a spurious correlation. To ensure that this is not driving our main results, we add interaction terms of the interbank funding shock with measures of geographical market share, geographical specialization, and the sector-specific maturity structure of a bank's portfolio. Geographical market share and specialization are calculated in a similar way as sector market share and

Table XI. Robustness on post-shock confounding events: potential impact of bank bail-outs

This table contains information on the estimated effect of deposit shocks ($\Delta\%$ Deposits$_b$) on credit supply, conditional on banks' sector market share and sector specialization. The dependent variable is percentage growth in the granted loan amount (Column 1), a dummy variable that is 1 if the granted amount increases and zero otherwise (Column 2), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Column 3). The independent variables of interest are the interaction between bank sector market share and sector specialization and the deposit shock. Panel A reports the results for specifications with the full sample, where we control for firm demand using firm cluster FE. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Panel B reports the results for specifications with the sample of firms borrowing from multiple banks only where we control for firm demand using firm-fixed effects. We control for all observed and unobserved bank-specific covariates by including bank-fixed effects. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

Panel A	(1) $\Delta\%$ Credit$_{bf}$	(2) Increase in credit$_{bf}$	(3) Large decrease in credit$_{bf}$
$\Delta\%$ Deposits$_b$ * Sector market share$_{bs}$	−1.501***	−2.564***	2.839***
	(0.464)	(0.613)	(0.866)
$\Delta\%$ Deposits$_b$ * Sector specialization$_{bs}$	−0.526**	−1.600***	0.937***
	(0.210)	(0.486)	(0.270)
Sector market share$_{bs}$	−0.010	−0.121	0.053
	(0.038)	(0.082)	(0.057)
Sector specialization$_{bs}$	0.038	0.204**	−0.101*
	(0.040)	(0.093)	(0.056)
Bank FE	Yes	Yes	Yes
Firm cluster FE	Yes	Yes	Yes
Observations	160,223	160,223	160,223
R-squared	0.298	0.282	0.292
Panel B	**$\Delta\%$ Credit$_{bf}$**	**Increase in credit$_{bf}$**	**Large decrease in credit$_{bf}$**
$\Delta\%$ Deposits$_b$ * Sector market share$_{bs}$	−2.421***	−2.047***	3.013*
	(0.648)	(0.664)	(1.751)
$\Delta\%$ Deposits$_b$ * Sector specialization$_{bs}$	−0.733	−2.250***	2.317***
	(0.494)	(0.755)	(0.525)
Sector market share$_{bs}$	−0.009	−0.043	0.065
	(0.075)	(0.094)	(0.118)
Sector specialization$_{bs}$	0.051	0.195	−0.282**
	(0.081)	(0.118)	(0.120)
Bank FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	47,205	47,205	47,205
R-squared	0.460	0.469	0.486

Table XII. Robustness: geographic specialization, loan maturity, and relationship strength

This table investigates alternative reallocation scenarios of the interbank funding shock (Δ% IBF_b) based on geographical bank market share and specialization, loan maturity specialization, and bank–firm relationship lending. The dependent variable is percentage growth in the granted loan amount (Columns 1 and 2), a dummy variable that is 1 if the granted amount increases and zero otherwise (Columns 3 and 4), and a dummy variable that is 1 if the growth in the granted loan amount belongs to the lowest quartile and zero otherwise (Columns 5 and 6). Both geographical market share and specialization are calculated in a similar way as sector market share and specialization, but at the province level instead of the sector level. The maturity structure indicator captures, at the bank-sector level, the share of loans that matures in more than 1 year. The two relationship lending proxies are the length of a bank–firm relationship, proxied by the number of months that a firm has an outstanding loan with a bank before 2008: 9, and a dummy indicating whether a bank is the main bank of a firm, calculated as the bank from which a bank borrows its largest share of credit in the 13 months before 2008: 9. Odd columns contain the results for specifications with the full sample, where we control for firm demand using firm cluster-fixed effects. Firm clusters are based on location-sector-size triplets for single-bank firms and on the firm itself for multiple-bank firms. Even columns contain the results for specifications with the sample of firms borrowing from multiple banks where we control for firm demand using firm-fixed effects. We control for all observed and unobserved bank-specific covariates by including bank-fixed effects. Firm controls include all interacted firm characteristics. Bank-sector and bank–firm controls include interacted bank-sector and bank–firm characteristics. Standard errors are clustered at the bank level. ***, **, and * denote $p < 0.01$, $p < 0.05$, and $p < 0.1$, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ% $Credit_{bf}$		Increase in $credit_{bf}$		Large decrease in $credit_{bf}$	
Δ% IBF_b	−0.750**	−0.877	−1.401***	0.0949	1.093**	0.801
* Sector market $share_{bs}$	(0.290)	(0.649)	(0.445)	(0.537)	(0.427)	(1.401)
Δ% IBF_b	−0.468**	−1.126***	−0.602	−1.804***	1.092**	2.045**
* Sector $specialization_{bs}$	(0.218)	(0.335)	(0.468)	(0.432)	(0.416)	(0.793)
Δ% IBF_b * Total $assets_f$	0.021	0.006	0.040	0.037	−0.027	−0.014
	(0.024)	(0.038)	(0.057)	(0.065)	(0.031)	(0.025)
Δ% IBF_b * Age_f	−0.000	0.001	−0.007**	−0.002	0.003	−0.000
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Δ% IBF_b * $Leverage_f$	0.203***	0.400***	0.468***	0.988***	−0.278	−0.544***
	(0.047)	(0.090)	(0.137)	(0.302)	(0.171)	(0.187)
Δ% IBF_b * Pledged $collateral_f$	0.025**	0.011	0.029	−0.017	−0.048**	−0.012
	(0.010)	(0.019)	(0.019)	(0.020)	(0.022)	(0.023)
Δ% IBF_b * Financial $pressure_f$	0.059***	0.101***	0.058**	0.101**	−0.055***	−0.087***
	(0.015)	(0.029)	(0.028)	(0.048)	(0.018)	(0.029)
Δ% IBF_b	1.748*	1.524	3.296**	4.629**	−0.868	−0.484
* Geographical market $share_{bp}$	(0.926)	(1.209)	(1.535)	(1.929)	(1.147)	(1.998)
Δ% IBF_b	−0.101	−0.0291	−0.462**	−0.667**	−0.110	−0.368
* Geographical $specialization_{bp}$	(0.126)	(0.245)	(0.213)	(0.307)	(0.234)	(0.362)
Δ% IBF_b * Maturity $structure_{bs}$	−0.099	−0.583**	−0.0245	−0.627*	0.081	0.592
	(0.190)	(0.274)	(0.320)	(0.344)	(0.319)	(0.397)
Δ% IBF_b * Length of $relation_{bf}$	−0.001	−0.001	−0.001	−0.002	−0.001	0.002
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)

(continued)

Table XII. Continued

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ% Credit$_{bf}$		Increase in credit$_{bf}$		Large decrease in credit$_{bf}$	
Δ% IBF$_b$ * Main bank$_{bf}$	0.0345	0.125**	0.260***	0.409***	−0.202	−0.332**
	(0.045)	(0.061)	(0.054)	(0.091)	(0.129)	(0.131)
Firm controls	Yes	No	Yes	No	Yes	No
Bank-sector controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank–firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm cluster FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	141,762	44,904	141,762	44,904	141,762	44,904
R-squared	0.370	0.470	0.322	0.477	0.344	0.496

specialization, but on the province level instead of sector level.[22] The maturity structure indicator captures the share of loans provided by a bank to a sector that matures within 1 year.

Results of these extended specifications are reported in Table XII. Most importantly, including these additional measures does not alter our main findings. The results on the reallocation effects based on sector market share and specialization as well as firm risk are very similar compared with the results reported in Table VI. Hence, our documented reallocation channels are robust relationships rather than spurious correlations driven by other possible reallocation channels.

Regarding banks' geographical orientation, we conduct two further tests, which are discussed in detail in the Online Appendix (Section A2). First, rather than measuring bank market share and bank specialization at the sector level considering Belgium as the relevant market, we now measure it by province. This does not impact our main results. Second, a recent strand of papers on the transmission of bank shocks in the USA shows that branch presence matters for shock transmission (Berrospide, Black, and Keeton, 2016; Gilje, Loutskina, and Strahan, 2016). This is unlikely to be of importance in our sample. Almost all loans (98%) are granted in provinces where the bank has a branch. Moreover, we do not find that branch network density matters for credit reallocation or that the reallaction channels documented in the body of this paper are affected by branch network density. An interaction term between the number of branches of a bank in a province and the interbank funding shock has the expected negative sign, but is never significant. The results of this additional test are discussed in more detail in the Online Appendix.

Finally, in the Online Appendix (Section A3), we also shed some light on potential differences between term credit and credit lines. On the one hand, it may seem easier for a bank to renegotiate the committed amount on a credit line (in case it is not yet fully utilized) than to cancel term credit. On the other hand, credit lines are also more likely to be given to better

22 Belgium consists of ten provinces. On average, a province has 1 million inhabitants and spans 3,000 km^2.

and well-known borrowers, hence they can be considered more like relationship-based, whereas term loans are more often seen as transactional (Berger and Udell, 1995). It thus remains an empirical issue whether and to what extent banks shield certain types of credit when facing a funding shock. We find that an outflow of interbank funding leads to a reduction in term credit supply. There is no statistically significant effect on the growth in granted credit line amounts. In addition, we do find that the average utilization rate increases following a bank funding shock. These results are consistent with Ivashina and Scharfstein (2010) and Ippolito et al. (2016). We also find that term credit borrowers in sectors where the bank has a larger market share are shielded more when the bank is hit by a funding shock. We do not find evidence of shielding in the credit line sample. It is also reassuring that there are no reallocation effects on the change in the utilization rate. Firms do not seem to choose drawing significantly more or less from banks with sector market share or sector specialization, indicating that the results we find in the overall sample (or in the term credit sample) are banks' choices and thus supply driven and not demand driven.

5. Expanding Post-shock Windows

In the Online Appendix (Section A4), we also present results using expanding post-shock windows to analyze the timing of the impact of the interbank funding shock. The purpose is two-fold. First of all, such an analysis can reveal time variation in the magnitude of the impact of an interbank funding shock on credit supply as well as in the credit reallocation channels. Secondly, it also serves the purpose of simply showing robustness of our main results for alternative post-event horizons. We do this expanding window analysis both on the baseline regression (as reported in Panel A of Table IV) and on the reallocation specification with sector market share, sector specialization, and firm characteristics (Column 1 of Panel A of Table VI).

This expanding window analysis yields a number of interesting and complementary insights. First, the results presented in Table IV are robust to varying the length of the post-event period, except for very short window lengths. It takes 3 months before the interbank funding shock starts to have a significant impact on credit growth. The impact on increase in credit and large decreases in credit is already significant after 2 months.

Furthermore, we find that the moderating impact of bank sector market share is almost instantaneous and stays significant until 2 years after the shock. Bank sector specialization on the other hand becomes important for the reallocation of credit after about 10 months and also stays significant until 2 years after the shock.

The moderating effect of firm risk becomes significant 3–4 months after the shock. Our results thus indicate that banks hit by a funding shock are at first more concerned with staying afloat in the short run by focusing on loans that ensure larger cash inflows (in the form of relatively high interest payments), while only being interested in long-term profitability (and hence focusing on protecting their sector-specific knowledge) and firm risk once these short-term inflows are safe.

6. Real Effects: Firm Investment and Growth

We have shown that banks operating in Belgium transmit interbank funding shocks to their borrowers according to their sector market share and specialization as well as by differentiating between firms with different risk profiles. In this section, we investigate how this reduction in bank loan supply affects firm investment and growth. We analyze this in the following setup:

$$\begin{aligned}\text{Real Effect}_f = {} & \psi_1\, \Delta\%\ \text{IBF}_b + \psi_2\, \Delta\%\ \text{IBF}_b * \text{Sector market share}_{bs} + \psi_3\, \Delta\%\ \text{IBF}_b * \\ & \text{Sector specialization}_{bs} \\ & + \sum_{x=1}^{5} \psi_{x+3}\, \Delta\%\ \text{IBF}_b * \text{Firm Variable}_f^x + \psi_9\, \text{Sector market share}_{bs} \\ & + \psi_{10}\, \text{Sector specialization}_{bs} \\ & + \sum_{x=1}^{5} \psi_{x+10}\, \text{Firm Variable}_f^x + \phi\, \text{Control Variables}_f + \upsilon_s + \epsilon_f. \end{aligned} \tag{6}$$

Real Effect$_f$ is computed as the difference between the last available value of the variable 2 years post-shock (i.e., end of 2010) and the last available value of the variable pre-shock, relative to the last available value of total assets pre-shock. We look at a 2-year post-shock horizon as changes in firms' strategies following credit constraints usually take time to materialize and show impact. The two dependent variables we are interested in are growth in tangible-fixed assets (net investment rate) and growth in total assets. β_1 captures the extent to which the interbank funding shock affects firms' real outcomes. If firms borrow from multiple banks, we compute a weighted interbank funding shock, with weights resembling the pre-shock bank–firm credit exposure. β_2 and β_3 capture whether the firm-level impact of the interbank funding shock varies with bank sector market share and specialization. Additionally, we interact the interbank funding shock with firm-specific risk, size, and age variables, similar to the setup in Table VI. We also control for accommodating sources of credit and investment or growth opportunities. This includes a measure of whether the firm received a new loan from a bank with which it had no prior relationship (weighted by the importance of the new loan in the post-crisis period), a measure whether a bank has terminated a loan with the firm, a dummy measuring whether the firm has loans with multiple banks, a measure of the change in the ratio of utilized over authorized credit, the change in the firm's reliance on trade credit, the firms pre-shock cash holdings, the firm's sales growth, and a set of sector-fixed effects.

Table XIII shows the corresponding results. The first two columns focus on the net investment rate (proxied by the growth in tangible-fixed assets). The results first of all indicate that firms borrowing from banks with a larger interbank funding outflow experience a statistically significant, though economically small, reduction in the investment rate. The point estimate of 0.083 for the funding shock variable in Column 1 of Table XIII indicates that the average firm in our sample which borrowed from a bank that experienced a funding shock of −10.3%, reduced its net investment rate by 0.85 percentage points. Interestingly, this small average result hides some important underlying heterogeneity. Column 2 indicates that firms borrowing from banks that have a high sector market share and large firms reduce their investment rate less than others. Based on the results in Column 2, the impact of an average interbank funding shock of −10.3% leads to a reduction of the investment rate by −1.16 percentage points for a firm of average size that is borrowing from a bank with average sector market share.[23] A firm of average size but

23 We use the summary statistics reported in Table I to calculate the impact. The average firm size is 13.38 and the average firm borrows from a bank which has a sector market share of 0.181 in its

Table XIII. Real effects: firm investment and growth

This table investigates the impact of the interbank funding shock (Δ% IBF$_b$) on firm investment and firm growth. Firm investment is proxied by the growth in tangible-fixed assets (Columns 1 and 2), firm growth is measured as the growth in total assets (Columns 3 and 4). The growth rate for both variables is computed as the difference between the last available value of the variable 2 years post-shock (i.e., end of 2010) and the last available value of the variable pre-shock, scaled by the last available value of total assets pre-shock. The independent variables of interest are the shock to interbank funding (Δ% Interbank funding$_b$) and its interactions with bank-sector-specific and firm-specific characteristics. The set of characteristics we consider is identical to the ones in Table VI. We include bank sector market share, bank sector specialization, firm size, firm age, leverage, pledged collateral to fixed assets, financial pressure, and cash holdings. The regressions include further controls for whether the firm received an additional loan from a new bank, for whether a bank terminated a loan with a firm, for whether the firm is borrowing from more than one bank, for the change in the ratio of utilized over authorized credit, for whether the firm increased its reliance on trade credit and for growth opportunities by including the firm's sales growth over the period and a set of sector dummies. Standard errors are clustered at the bank level. ***, **, and * denote $p<0.01$, $p<0.05$, and $p<0.1$, respectively.

	(1)	(2)	(3)	(4)
Variables	Δ% Fixed assets$_f$		Δ% Assets$_f$	
Δ% IBF$_b$	0.083**	1.114***	0.041	1.073*
	(0.040)	(0.423)	(0.054)	(0.647)
Δ% IBF$_b$ * Sector market share$_{bs}$		−0.834***		−0.787
		(0.279)		(0.537)
Δ% IBF$_b$ * Sector specialization$_{bs}$		0.002		0.291
		(0.206)		(0.348)
Δ% IBF$_b$ * Total assets$_f$		−0.064**		−0.073
		(0.028)		(0.045)
Δ% IBF$_b$ * Age$_f$		−0.004		−0.001
		(0.002)		(0.002)
Δ% IBF$_b$ * Leverage$_f$		−0.184		−0.095
		(0.119)		(0.167)
Δ% IBF$_b$		−0.005		−0.008
* Pledged collateral to fixed assets$_f$		(0.019)		(0.022)
Δ% IBF$_b$		−0.008		−0.003
* Financial pressure$_f$		(0.018)		(0.036)
Firm controls	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	114,435	114,435	114,435	114,435
R-squared	0.152	0.152	0.337	0.337

borrowing from a bank with an average interbank funding shock of −10.3% for which the sector market share is one standard deviation lower, however, reduces its net investment

sector. As such, the impact of an average interbank funding shock of −10.3% equals $-0.103 * [1.117 + (0.181 * -0.744) + (13.38 * -0.065)] = -1.16$ percentage points. We do not take into account the remaining interaction terms given that their impact is not statistically different from 0.

rate by about −1.80 percentage points. Similarly, a firm that is borrowing from a bank with an average funding shock of −10.3% and an average sector market share but that is a standard deviation smaller than the average firm will reduce its investment growth slightly more than two percentage points. The last two columns show the impact of the interbank funding shock on asset growth. As with investments, firms that borrow from a bank with a more negative interbank funding shock grow slower than other firms. Reallocation effects based on firm size are similar to the effects found for fixed assets.

Overall, we find a moderate reduction in investment and asset growth for firms that are borrowing from banks that were hit harder by the interbank funding shock. Borrowing from a bank with high sector market share helps to offset this negative impact on investment. While the result on asset growth with respect to bank sector market share is similar, it is not statistically significant. Additionally, large firms are better able to limit the reduction in investment after an interbank funding shock. Given that Table VI showed that there are no significant differences between small and large firms in terms of the credit supply shock they both receive, the smaller impact in terms of real effects for large firms might indicate that these firms have more alternative funding sources available, over and above those controlled for.

7. Conclusion

We conduct a comprehensive analysis of the sector- and firm-specific strategies that banks follow when their funding is affected by a negative shock. While the current literature mainly focuses on the average impact of funding shocks on the volume of bank lending, we investigate the reallocation that occurs across sectors and firms and its persistence over time.

To identify the reallocation in the supply of credit that follows from the difficulties for banks to obtain funding, we rely on a unique combination of data sets. We employ monthly bank–firm level credit data from a comprehensive credit register that contains all credit granted in Belgium by financial institutions, monthly balance sheet data of these financial institutions, and annual balance sheets of all registered firms.

We start by benchmarking our study with related studies. The average firm in our sample borrows from a bank that experiences a contraction in funding equivalent to 10.3% of its total assets. We estimate that the average firm, as a direct consequence of this funding outflow, faces a decline in the supply of credit by 4.26%. An investigation of the timing and duration of this effect reveals that the funding shock significantly impacts credit supply already 4 months after the shock started, reaches a maximum impact after 9 months, and remains significant and high up to 24 months after the shock.

Our main results indicate that a bank's business model, as reflected in its sector market share and sector specialization, determines the reallocation of credit when a bank is hit by a negative funding shock. Sector market share measures how important a bank is for a particular (non-financial) sector while sector specialization measures how important a (non-financial) sector is for a bank. We find that a standard deviation increase in sector market share reduces the negative impact of the funding shock on credit supply by 22% for the average firm. Similarly, a standard deviation increase in sector specialization reduces the negative impact of the funding shock on credit supply by 8% for the average firm. Hence, banks direct their attention to sectors where they can more easily extract rents (higher sector market share) or where they have built up superior knowledge (higher sector specialization). Additionally, we document the existence of a flight to quality. Banks reallocate credit toward firms with low debt levels, low default risk, high available collateral, and a high interest coverage ratios. Importantly, this flight-to-quality coexists with the two aforementioned reallocation effects.

The reallocation effects are also robust to a number of alternative explanations. We provide evidence that our results are not driven by pre-shock solvency problems, government interventions during our sample period, banks' geographical specialization, or bank–firm relationship characteristics.

On the real side, we find a moderate reduction in investments and asset growth for firms borrowing from banks that were hit harder by the funding shock. The average firm borrowing from a bank that experienced an average funding shock reduced its net investment rate by 0.85 percentage points. Importantly, we show that firms that are borrowing from a bank with high sector market share can partially offset this negative impact on investment rates.

Our results provide useful information for policy makers that want to ensure access to finance for non-financial corporations during crisis times, as we show that riskier firms and firms borrowing from banks that have low sector market share and specialization are more vulnerable to shocks in the banking sector. Firms may prefer matching with banks with a larger sector market share as the implied higher cost of borrowing during good times also acts as an insurance premium that guarantees access to finance when the bank faces a funding shock [as in Petersen and Rajan (1995) and Berlin and Mester (1999)]. Firms might even be able to get this extra protection for free if they borrow from a bank with high sector specialization, given that these banks do not charge higher rates. At the same time, our results indicate that market share has a somewhat stronger shielding effect than specialization, which might explain why firms are still willing to pay a higher price and borrow from the high market share bank. Whether these trade-offs impact firms' borrowing decisions and how this affects the pool of borrowers available to banks are interesting questions for future research.

Our findings also contain interesting information for bank regulators. Our results reveal a bright sight of lending concentration during crisis times and are thus informative when making the trade-off between portfolio concentration risk and having sufficient information about borrowers. Finally, our results suggest that not only systemic risk and financial stability issues should be taken into account when studying the welfare implications of portfolio diversification, but that it could also be relevant to consider the potentially beneficial impact of lending concentration on firm credit supply.

Supplementary Material

Supplementary data are available at *Review of Finance* online.

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